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COVER PLANTS.

The realisation of the serious effects which may accrue as a consequence of soil erosion has reawakened interest in cover plants, and during the last few months numerous specimens of indigenous plants which might serve as such have been submitted to the Department of Agriculture for report.

Many will remember the beginning, some twenty years ago, of the movement in favour of growing, among our permanent cultivations, some plants the benefits of which were indirect and not immediately expressible in terms of the crop return. Such plants were grown primarily for green manuring, and as the object was to obtain a large quantity of green material, shrubby plants or trees were chiefly employed. Green manuring in Ceylon is now a well-established practice, and it generally takes the form of growing trees or large bushy plants which do not crowd the permanent crop and can be lopped periodically.

With the advent of rubber, the need of some protection of the soil in the early stages was soon perceived, and the existing green manure plants were pressed into service. As a rule, the smaller shrubby plants, e.g., *Crotalaria striata*, were used, though even dadaps, densely planted, were tried. As a protection from deterioration of the soil by exposure to the sun, and from the point of view of green manuring, these plants served a useful purpose, but they were not satisfactory in preventing soil erosion.

When the slump in rubber occurred in 1907, the same plants were asked to undertake another function. Money was not available for the upkeep of young estates, and green manure plants were sown with the idea of preventing the growth of weeds and so doing away with the necessity of weeding. In some cases, at least, they failed to do that, and because of that failure the practice of growing cover plants was somewhat discredited.

The point which it is desired to emphasise is that we have generally asked too much of our plants. A plant which serves excellently as a green manure is not necessarily a good cover plant. And though cover plants will no doubt keep down weeds to some extent, one must not be disappointed if they do not obliterate them completely.

For the prevention of soil erosion, creeping or prostrate plants are generally to be preferred. Erect single-stemmed plants are not advisable, as the surface water may cut channels between their stems, though if closely planted as a hedge across a slope they may prove successful. But in the preservation of the banks which protect lands from flooding in temperate countries, erect shrubby plants are rigorously eliminated because of their tendency to induce erosion channels.

Several introduced species are now under trial for the prevention of soil erosion. There are, however, numerous indigenous plants which might serve equally well, and it is probable that in every district in Ceylon there is some plant which could be used for this purpose. In selecting such plants it is necessary to exercise some caution, and not to introduce a species which will obviously be difficult to eradicate, if and when it is desired to get rid of it. One of the main advantages of the introduced species is that a supply of seed is available. But they are all wild in some country, and some one has to raise the stock.

It is proposed, as opportunity offers, to publish illustrations of Ceylon plants which are being tried for the prevention of soil erosion, or which are worth considering for that purpose ; and illustrations of three species of *Desmodium* are included in our present number.

TEA.

THE CONDITION OF TEA-SEED BEARER FIELDS.*

C. P. COHEN STUART.

(Translated by H. L. Ludowyk, Librarian, Department of Agriculture, Ceylon).

The tea planters of Java have, as a rule, taken pains to lay out good tea-seed gardens: the establishment of 65 well-isolated gardens, and 31 from more or less well-selected seed, is a satisfactory result. As I have already said, there are tea-seed gardens of good reputation that are not isolated, so that isolation in itself does not determine the value of a field of tea-seed bearers, but it is clear, from the great number of isolated tea-seed gardens, that it has been understood that a tea-seed garden must be more than a mere tea field where seed may be collected, and that the importance of controlled seed-breeding has been realised.

That is especially true of those estates which sought the aid of the Tea Experiment Station in establishing good tea-seed gardens. The Experiment Station had promised help in that matter, and when enquiries on the subject began to come in, it afforded assistance in accordance with certain rules and conditions laid down elsewhere. According to the conditions, the expenses incurred on the fields have to be borne by the estate, which, in return, is entitled to any profits that accrue; while the Experiment Station has the right to various data concerning the garden, and is entitled to a certain quantity of seed for the purpose of carrying on further experiments in selection.

The duty devolving on the Experiment Station consists in carrying out the work of selection, the choice of the best plants in the nurseries and again in the seed-bearer fields. Several seed gardens have already been laid out in this way, and although naturally no guarantee can be given that the progeny will make an ideal seed type, since our experience in this matter is as yet insufficient to enable any definite statement to be made regarding the descendants, nevertheless, each of these fields has been laid out with as much care, and the selection of the plants has been made as strictly, as in the case of the tea-seed plots in the Government Cinchona Estate, Tjinjiroean.

This assistance can be rendered only in the case of seed gardens yet to be laid out. Nothing much can be done on already existing plantations. Older trees show the characters on which selection is based only to a slight degree or not at all. Most tea-seed bearers lose a great part of their foliage and appear more or less unsightly. It may be that some are more thickly covered with leaves, and are provided with a greater profusion of rather

* Section 3 of Meded. van Het Proefstation voor Thee, No. LXXV (1921). C. P. Cohen Stuart. *De Theeuzaadtuinen van Sumatra en Java.*

strong branches than others, but, on the whole, it is very difficult to make a selection. The little that can be done on such a seed garden lies not in the domain of seed selection, but of garden maintenance.

The most important of the measures to be taken in the case of old tea-seed gardens is thinning out. Most of the fields of tea-seed bearers are far too thickly planted. When the foliage of one tree grows in among that of its neighbours and the trees deprive one another of light, flowering and the setting of fruit can never reach their fullest development, since, for both these functions, abundant light is one of the first needs. Besides, when the shade of the branches cuts off too much light from the ground, the seeds that fall and lie on it rot very fast. We have for these reasons adopted for our seed-bearer fields in Tjinjiroean the rule that stumps are to be planted 6 ft. by 6 ft., and that the plants shall be thinned out to 12 x 12 ft. (625 per Hectare) as soon as their branches touch one another. If, later on, that appears to be too close, and the trees interfere with one another, the number is reduced 400 per hectare (195 per acre) or even less.

The adoption of extremes with regard to spacing is well exemplified by the following two cases. One estate planted on its seed-bearer fields 1940 trees per hectare (785 per acre), while another had on its fields only 100 trees per acre. The first is much too close, and the second too wide. The crop in the latter case will remain low, while the cost of upkeep—especially as in this case green manures have been used abundantly—will be high.

In addition to thinning out, more light and air can be made available to the trees by pruning. It is best to prune when the plants are rather young, for it is then easy to obtain a fairly regular branch system, and to keep it constant. The pruning of older trees entails the undesirable task of sawing away thick branches, whereby large wounds are caused which have to be treated with a coating of tar; and, moreover, a regular wide branching cannot be induced at that age. Yet trouble taken in late pruning is not entirely without its reward. The aim of the pruner should be to leave thick and leafless main branches only in the middle of the tree, and to cause all the leaves and flowers to appear at the circumference. Thin branches should, for this reason, be eliminated from the centre of the trees, and also all thicker branches which stand too close to one another or grow across. These principles of pruning just enumerated are analogous to those entailed in what in coffee cultivation is known as "Kokersnoei" (Koker pruning)*

It is also worth while to remove epiphytes and parasites from the tree. In some seed-bearer fields lichens are found in abundance on the stems and branches, and the existence of these cannot possibly be conducive to the health of the tree. In other fields these lichens never make their appearance, or, they are scraped off the bark whenever they appear, to the height which a man can reach. High branches that are all too thickly covered with these lichens can be sawn off, for they are, in most cases, half dead. One estate, following the example of fruit-growers in Holland, had recourse to an application of lime for destroying these lichens. Some months later,

* It is generally believed that this word signifies that the method when adopted induces the leaves to form around the tree, in the form of a hollow case or sheath (Dutch, Koker= case, sheath). In TEIJSMANNIA, Vol. XXIV, 1913, p. 171, on the other hand, we read that this method of pruning is named after the Administrator, KOKER.

when the lime had all been washed away by the rains, not only had all the lichens been killed, but, as it seemed, a thick sound bark had formed.

Such epiphytes (*i. e.* organisms that grow on other bodies but do not draw on them for their sustenance) might be allowed to remain, so long as they do not develop to too great an extent. It is entirely different in the case of parasites, which derive their food from the tree. The well-known *Loranthaceæ* (*Loranthus Korthalsii* Molkenb.), a close relation of the Bird-lime or Mistletoe (*Viscum album*,) should be carefully eradicated. This parasite is believed to be disseminated most probably by birds.* As the haustoria of the parasite become embedded deep in the tissues of the tree, the most rigid methods of control should be adopted and persistently carried on, until the last fragment has been got rid of.

An insect parasite that one has carefully to guard against in seed-bearer fields is the tea-seed fly (*Adrama determinata*) which has been fully described by HEER LEEFMANS in MEDEDELING No. XXXV. Another serious pest of tea seed is the tea-seed bug (*Poecilocoris Hardwickii*) which English writers suppose to be the cause of a fungus growth on the seed, through puncturing the immature fruit. The investigations I carried on with regard to these diseased seeds have made it appear that these spotted seeds cannot rightly be spoken of as having fungus growth on them although we have thus far, on the authority of English writers, used this term in connection with seed control. The peculiar white spots on the cotyledons are accumulations of starch which result from punctures made by the seed bug. Since the seeds thus injured soon begin to deteriorate and putrefy, seed from estates that are largely infested with seed bugs soon gets a bad reputation. Even if the seed is tested and selected with the greatest care, it is found that within a few weeks a large percentage of the sinkers become floaters; and consequently claims from the purchasers are the result. Fortunately, the injurious insects are easily noticed and captured. Not only is the control of the bug absolutely necessary, but the labour given to destroying the pest is amply rewarded.

Whether the "deterioration" of certain seed gardens, which has already been referred to, and which it has not been possible to correct by manuring and hard pruning, also depends upon the occurrence of *Poecilocoris* is a question which must be determined by special investigation.

As regards cultivation in tea-seed gardens, estates do not generally take much trouble; and, in my opinion, that is right. Continual digging, forking and manuring is conducive to the copious production of leaves, and this is in place in a plucking field; but for the production of flowers and fruits, it is of little use, or it might even be accounted injurious. Local soil conditions and other local factors should not be lost sight of.

In one of the new seed gardens, established in precise accordance with the method adopted on Tjinjiroean, very careful cultivation was resorted to, and planting holes not less than one cubic metre were dug. The methods that are possible in the latter district on ground rich in humus are not everywhere practicable. The above-mentioned garden was situated on soil which was not very rich in humus, and when the ground was worked to

* According to a communication made by HEER BARTELS, Administrateur of Pasir Datar, the principal agent in the spreading of the parasite is *Dicæum sanguinolentum*

the depth mentioned, the thin layer of humus was simply distributed through a great mass of unweathered soil. The result was that the selected stumps in the garden struck root very poorly, and grew very slowly. Analyses of the soil made by HEER DEUSS showed that the nitrogen content of the top soil outside the tea-seed bearer field (land which had not received cultivation) was 0·50%, whilst that of the part of the seed-bearer fields where the trees grew worst was not more than 0·28%. More striking still was the soil section in the planting holes; in the forest soil there were 22 cms. humus, 11 cms. light brown clay, 12 cms. of a grey layer, under that 30 cms. a reddish brown clay, and finally, a yet darker coloured clay to an unknown depth; in the seed-bearer plots, however, there were 40 cms. of a mixture of humus, clay and gravel, and below that a yellowish clay to an unknown depth. This ground was simply spoilt by too thorough cultivation. The only remedy now is to plant leguminous crops in order to try to increase the nitrogen content of the soil.

In such cases the use of green manures is necessary. The majority of the seed gardens, which have been laid out on ground obtained by the clearing of virgin forest and are not as a rule deficient in nitrogen, have nothing to gain by their being planted with legumes. On ground rich in nitrogen, leaf production tends to be excellent, but flower and fruit production so much the smaller. In seed gardens, therefore, a deficiency of nitrogen is to a certain extent an advantage rather than a disadvantage.

This is a consideration of particular importance especially in the case of seed gardens established for seed selection. I have already pointed out in my former communication that it is a cardinal fault to overdose a seed selection garden with nitrogen and to cultivate it too frequently, because the vegetative growth is thereby stimulated, and it is difficult to make a selection from the overgrown plants. If the selection has already been carried out, then there is no objection to planting leguminous plants in the parts of the field that are obviously poor.

When sloping ground is being opened up for seed-bearer fields it is advisable to have terraces in order that they may serve the dual purposes of preventing soil wash and of facilitating the gathering of the seed. On some estates these terraces are also reinforced with bamboo frame work. On the other hand, catch pits are generally of no advantage, for the seeds roll into them and it is very difficult to have them gathered. The more even the land is and the cleaner it is kept, the easier it is to harvest the seed. That it should not be left lying on the ground is not only of importance financially but is a prime factor in dealing with the seed fly.

Something has also to be said regarding the harvesting. In spite of the repeated warning given against such an error, it often happens that the fruits are picked from the seed-bearers instead of being left till they open of themselves and let the seed fall on the ground. If one knew for certain when the seeds in the unopened fruits were ripe, then there would be no harm in picking the fruits, at least if one could make certain that the coolies gathered only the fully ripe fruits. It is practically impossible, however, by merely inspecting the exterior of a fruit, to know whether it is ripe; and, consequently, if picking is done, the collection of unripe seed is naturally unavoidable.

Sometimes one seed of a fruit might be ripe while the other two are unripe. The unripe seeds are not yet fully developed. The embryo is yet embedded in its succulent endosperm, which squirts out when the seed is opened. This viscous matter, the endosperm, forms the food of the embryo, which, when fully developed, absorbs the whole of the watery mass and fills the seed completely. When the fruit is prematurely picked, however, the watery endosperm simply dries up, allowing air to enter into the seed and fill the vacancy; and the result, as is well known, is that such seeds float in water. If such seeds be shaken, we can often hear the loose embryo knocking against the shell of the seed. A plucked fruit may contain one normal seed and two floaters. If the seeds are despatched soon after plucking, they may appear to be all sinkers, but in transit the seeds dry and the recipient obtains a good quantity of floating seed.

On this account the picking of seeds from the trees should be strictly avoided. Seed should not, on the other hand, be allowed to lie too long, to deteriorate and to be attacked by the seed fly. It is best to collect the seed two or three times every week.

Another mistake that is very often made is to pay the coolies who gather the seed according to the amount of seed each man collects. This is the best method of encouraging the collectors to pick seed from the trees, or to gather seed from the plucking fields, or from village gardens. In order to eliminate such malpractices it is absolutely necessary to employ coolies who work for a daily wage.

I will now deal to a certain extent with the phenomenon of the varying production of tea-seed gardens, apart from any effect due to insect pests. This is a phenomenon that is not restricted to tea-seed bearer fields alone. It is very usual in European orchards to find that a heavy crop and a poor one follow each other alternately; and the well-known Englishman, S. PICKERING, has attributed this to certain external conditions. In order to satisfy myself whether these variations occur in tea-seed gardens, I requested the Administrator of Kertamanah, HEER JONGKINDT CONINCK, to supply me with statistics showing the monthly production of tea-seed in his seed garden during the nine years from 1909 to 1917. From the figures he has so kindly supplied me, I have drawn a graph, and also a graph of the rainfall of the period. One sees from the graph that there is no evidence of any regularity in variation. The seasons in which the largest crops were harvested were the second halves of the years 1913 and 1916, but in the year 1910 there is not a corresponding unusually large increase, although the crop was relatively good.

Great variation has also been noticed in the quality of the crop. Lately we received information from Deli that the seed received there during the last half year contained a very low percentage of sinkers. The seed they received was not from one estate only; nor was the seed obtained from Java only, but from different seed gardens in British India too. As to the cause of this phenomenon we yet simply grope in the dark, for we must imagine some climatic influence which affected the whole of South-eastern Asia.

Besides, it is difficult to ascertain, at what period this climatic or other influence exerted its power over the seed-bearers so as to affect the production of seed. We know that the tea-seed ripens in from 10 to 12 months

after flowering; we know also that the flower buds were in existence for several months before they bloomed, even nearly half a year. Conditions, therefore, which have induced profuse flowering have to be sought for half year before the flowering, and one and half years before the seed is gathered. And at present it has not been claimed that heavy or poor crops strictly follow as a consequence of profuse or sparse flowering. We know very well that in the Dutch orchards a poor crop of fruit sometimes follows profuse flowering owing, sometimes, to a night frost, which, occurring in the early stage of the blossoming period, destroys the rudimentary fruits. It may also happen that in a certain year profuse flowering occurs, whether under favourable conditions or not, and that, owing to unfavourable conditions which set in some weeks or months later, the crop leaves much to be desired. Now, if we want to arrive at some estimate of the crop in the coming year, say 1923, at what time are we to decide. Should we judge at the time of the appearance of the buds at the beginning of 1922? or at the flowering period at the end of the same year? or during the development of the young fruits in the year after? Will the drought of the East monsoon of 1922 exert the most powerful influence, or will the trees be most affected by the rains of the West monsoon from 1922 to 1923? This is an exceptionally difficult problem to solve, and we must content ourselves with watching what our seed-bearers will produce in the coming year, without being able to prophesy about it.

TEA CULTIVATION IN THE STATE OF SAO PAOLO, BRAZIL.

C. LOHAMANN.

Report made to the Minister of Agriculture by the author giving an account of his travels in the State of Sao Paolo for the purpose of studying the cultivation and preparation of tea.

Tea-growing in this State dates from the beginning of last century, the seed used having probably come from the Rio Janeiro Botanic Gardens. In 1852, the total production of the State was nearly 30,000 kg., *viz.*, about one-tenth of the present consumption, and there were already 30 agricultural tea-factories in various municipalities (Itu, Capivary, Piracicaba, Porto Felix, Sao Roque, etc.). Afterwards tea production decreased owing to some extent to the preference shown for coffee and to the abolition of slavery but chiefly in account of the poor quality of the product which was much inferior to Assam tea. Since there is no doubt that the country is suitable for tea cultivation (which would be more profitable than coffee-growing), all that is necessary is to use selected seed from the best centres of production. The whole district, from Mogy das Cruzes to Sao Roque, and from Parnhyba to Jundiahy, which is almost useless for coffee, would be very suitable for tea. The chief centre of production at present is Murumby, but the crops now amount to barely one-fifth of those in the middle of last century. In many places, there are still plants growing in the old tea-gardens which shows how well they have become acclimatised.—INTERNATIONAL REVIEW OF SCIENCE & PRACTICE OF AGRICULTURE, Vol. II., No. 1.

RUBBER

THINNING OUT RUBBER.

In a recent article in this Journal, the statement was made that in thinning out by yield determinations, some trees are retained which are good yielders but have few latex vessel rows, whereas in thinning out in accordance with counts of the latex vessel rows, some trees are retained which have a large number of latex vessel rows but are poor yielders. This was demonstrated to the Estate Products Committee two years ago, and about the same time, the same deduction was published by ARENS in Java. It is not, however, generally recognised that this must be the case, and in response to a request for an explanation the following example is given in illustration of the point.

161 trees on the Experiment Station, Peradeniya, the yields of which had been recorded individually, were examined by BRYCE and GADD, and the number of latex vessel rows in each determined. The results of this examination were published in Bulletin No. 55 of the Department of Agriculture.

To summarise this part of the results of the investigation a table has been made showing at the same time the number of trees which give a certain yield, and the numbers of latex vessel rows in those trees. For this purpose the trees are grouped in classes according to yield, the yield of each class differing from the next by 200 grams: that is, all trees which yield from 1,000 to 1,199 grams are placed in the 1,100 gram class, those which yield from 1,200 to 1,399 grams in the 1,300 gram class, and so on. At the same time, the trees in each class are divided into groups, those of each group having the same number of latex vessel rows. We then have the following table.

Yield in Grams	Number of Latex Vessel Rows																	Number of Trees
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1,100	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
1,300	1	1	3	.	1	3	2	.	.	.	1	.	.	.	.	.	.	12
1,500	1	2	3	1	7	6	1	2	1	2	.	1	.	.	.	.	.	27
1,700	1	1	3	5	2	5	1	7	3	4	.	1	.	.	.	.	.	33
1,900	.	.	1	2	2	3	8	6	2	3	3	.	.	.	.	.	.	30
2,100	.	.	1	1	3	3	2	6	2	3	3	1	2	1	.	.	1	29
2,300	.	.	.	1	1	3	2	4	1	1	1	3	.	.	.	.	.	17
2,500	.	.	.	.	.	.	2	1	1	.	3	.	.	1	.	.	.	8
2,700	.	.	.	.	.	.	.	1	1	.	.	.	.	1	.	.	.	3
2,900	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
3,100	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
Number of Trees	3	4	11	10	16	24	18	27	11	13	12	6	2	3	0	0	1	161

The table shows that in the 1,100 gram class, there is one tree, and that has ten latex vessel rows. In the 1,300 gram class, there are twelve trees—one with five latex vessel rows, one with six latex vessel rows, three with seven, one with nine, three with ten, two with eleven and one with fifteen. The first column gives the yield of the class, and horizontally from each figure of yield one finds the number of trees which give that yield and have the number of latex vessel rows indicated at the top of the table. Such a table is known as a correlation table: it shows in this case the relation between yield and number of latex vessel rows.

Now, suppose that it is required to thin out half the trees, 80, by selection. If the trees are selected according to the number of latex vessel rows, those with the fewest latex vessel rows will be discarded. The latter are the trees represented by the numbers in the columns to the left of the table. All those in the first six columns will be discarded, and, to make up the eighty, twelve of those in the seventh column. We will assume that the six best yielders of those in the seventh column are retained. We may then draw a vertical line from the top of the table between the sixth and seventh columns, as far as the figure 8, and thence between the fifth and sixth columns to the base. All trees represented by the numbers to the left of that line will be discarded, and all to the right retained.

The consequence of thinning out in accordance with determinations of yield is shown in the table below. In this case, the poor yielders are discarded, and these are the trees represented by the numbers in the upper part of the table.

Yield in Grams	Number of Latex Vessel Rows.																	Number of Trees
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1,100	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
1,300	1	1	3	.	1	3	2	.	.	.	1	.	.	.	.	.	.	12
1,500	1	2	3	1	7	6	1	2	1	2	.	1	.	.	.	.	.	27
1,700	1	1	3	5	2	5	1	7	3	4	.	1	.	.	.	.	.	33
1,900	.	.	1	2	2	3	8	6	2	3	3	.	.	.	.	.	.	30
2,100	.	.	1	1	3	3	2	6	2	3	3	1	2	1	.	.	1	29
2,300	.	.	.	1	1	3	2	4	1	1	1	3	.	.	.	.	.	17
2,500	.	.	.	.	.	.	2	1	1	.	3	.	.	1	.	.	.	8
2,700	.	.	.	.	.	.	.	1	1	.	.	.	.	1	.	.	.	3
2,900	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
3,100	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
Number of Trees	3	4	11	10	16	24	18	27	11	13	12	6	2	3	0	0	1	161

All the trees represented by the numbers in the first four rows of the table will be discarded, and, to make up the eighty, eight of those in the fifth row. We will assume that in the fifth row the eight with the fewest latex vessel rows are discarded. We may then draw a horizontal line across the table as shown. All the trees epresented by the numbers above

this line will be discarded, and those below the line retained. (The line should pass diagonally through the three in the sixth column, because one of those trees must be retained in order to keep eighty-one ; it has been drawn as shown to avoid difficulty in printing.)

To show the difference in thinning out by the two methods, the two tables are combined below.

Yield in Grams	Number of Latex Vessel Rows																Number of Trees
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1,100	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
1,300	1	1	3	.	1	3	2	.	.	.	1	.	.	.	.	.	.	12
1,500	1	2	3	1	7	6	1	2	1	2	.	1	.	.	.	.	.	27
1,700	1	1	3	5	2	5	1	7	3	4	.	1	.	.	.	.	.	33
1,900	.	.	1	2	2	3	8	6	2	3	3	.	.	.	.	.	.	30
2,100	.	.	1	1	3	3	2	6	2	3	3	1	2	1	.	.	1	29
2,300	.	.		1	1	3	2	4	1	1	1	3	.	.	.	.	.	17
2,500	.	.	.	.	.	.	2	1	1	.	3	.	.	1	.	.	.	8
2,700	.	.	.	.	.	.	.	1	1	.	.	.	.	1	.	.	.	3
2,900	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
3,100	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
Number of Trees	3	4	11	10	16	24	18	27	11	13	12	6	2	3	0	0	1	161

The vertical and horizontal lines divide the table into four sections. It will now be evident that whichever method of selection is adopted, the trees represented by the numbers in the upper left-hand section will be discarded and those in the lower right-hand section retained. But in thinning out by counts of latex vessel rows, those in the lower left-hand section, which are good yielders with few latex vessel rows, will be discarded, and those in the upper right-hand section, which are poor yielders with a large number of latex vessel rows, will be retained ; whereas in thinning out by yield those in the upper right-hand section will be discarded, and those in the lower left-hand section, the better yielders, retained.

The table in this case is the usual shape of a correlation table, *i. e.*, the arrangement of the numbers in a normal correlation table is of the same character as in this. Any two lines drawn horizontally and vertically across a normal correlation table, in such a way as to divide the total number in the same ratio in each case, will give four similar sections. Consequently the proposition is a general one, *i. e.*, it must always happen in a normal group of trees that in selecting by counts of latex vessel rows, some good yielders are discarded and some poor yielders retained.

SOILS AND MANURES.

COVER PLANTS.

The larger leguminous plants, such as *Tephrosia candida*, which have been extensively used for green manuring, are not so suitable for use as cover plants to prevent soil erosion. For the latter purpose a smaller plant is required, and a prostrate plant, if possible. If erect plants with stout stems are used, the surface water will probably cut channels between the stems, unless the plants are grown close together in hedges.

Several estates are now making trials with indigenous plants, especially with species of *Desmodium* in the low-country. Up-country, on the Uda Pussellawa side, *Cassia mimosoides* is beingtried. Several other species of leguminous plants, *Phaseolus*, etc., would appear suitable. Leguminous plants are common and generally distributed in Ceylon, and it is probable that there is some species in each district which would serve as a cover plant. Of course, cover plants need not be restricted to the Leguminosæ, but the latter have the additional advantage of gaining nitrogen from the air.

In order to facilitate the identification of these indigenous plants, it is proposed to publish illustrations of them in this Journal, as opportunity offers. In this number, figures are given of three species of Desmodium, viz., *Desmodium triflorum*, *Desmodium heterophyllum* and *Desmodium heterocarpum*. All these are nitrogen collectors, and common in the low-country.

Desmodium triflorum DC. (Plate I. natural size). This is known as Heen-undupiyali, the small undupiyali, by the Sinhalese. It is one of the plants referred to as Shamrock by European planters, the other being *Oxalis corniculata*. It is perennial, and grows prostrate, closely applied to the ground, forming a flat mat, with many slender stems radiating from a rather stout root. The stems are slightly hairy. The leaves are the usual clover shape, small, the leaflets being from a quarter to three-eighths of an inch long. Sometimes the lower leaves have only one leaflet. The flowers are bright purple, in shape like a pea flower but very small, usually three together on slender stalks. The pod is jointed, with from two to four joints. It is common in the low-country and up to an elevation of 2,000 feet, or probably higher, and forms one of the major constituents of open grass land. It is expected that it will be possible to fork through a cover of *Desmodium triflorum*, without destroying the plant. It is used in native medicine in the treatment of fevers.

Desmodium heterophyllum DC. (Plate II. natural size). The Sinhalese name of this is Maha-undupiyali, the big undupiyali, though it is not as large as the next. It is a prostrate plant, of the same habit as *Desmodium triflorum*, but with coarser stems, larger leaves, and a more open mat. The stems are densely hairy, and the spreading branches root freely at the nodes. The leaves are like clover leaves, but the terminal leaflet is larger than the other two; the plant was given the name *heterophyllum* because of the marked

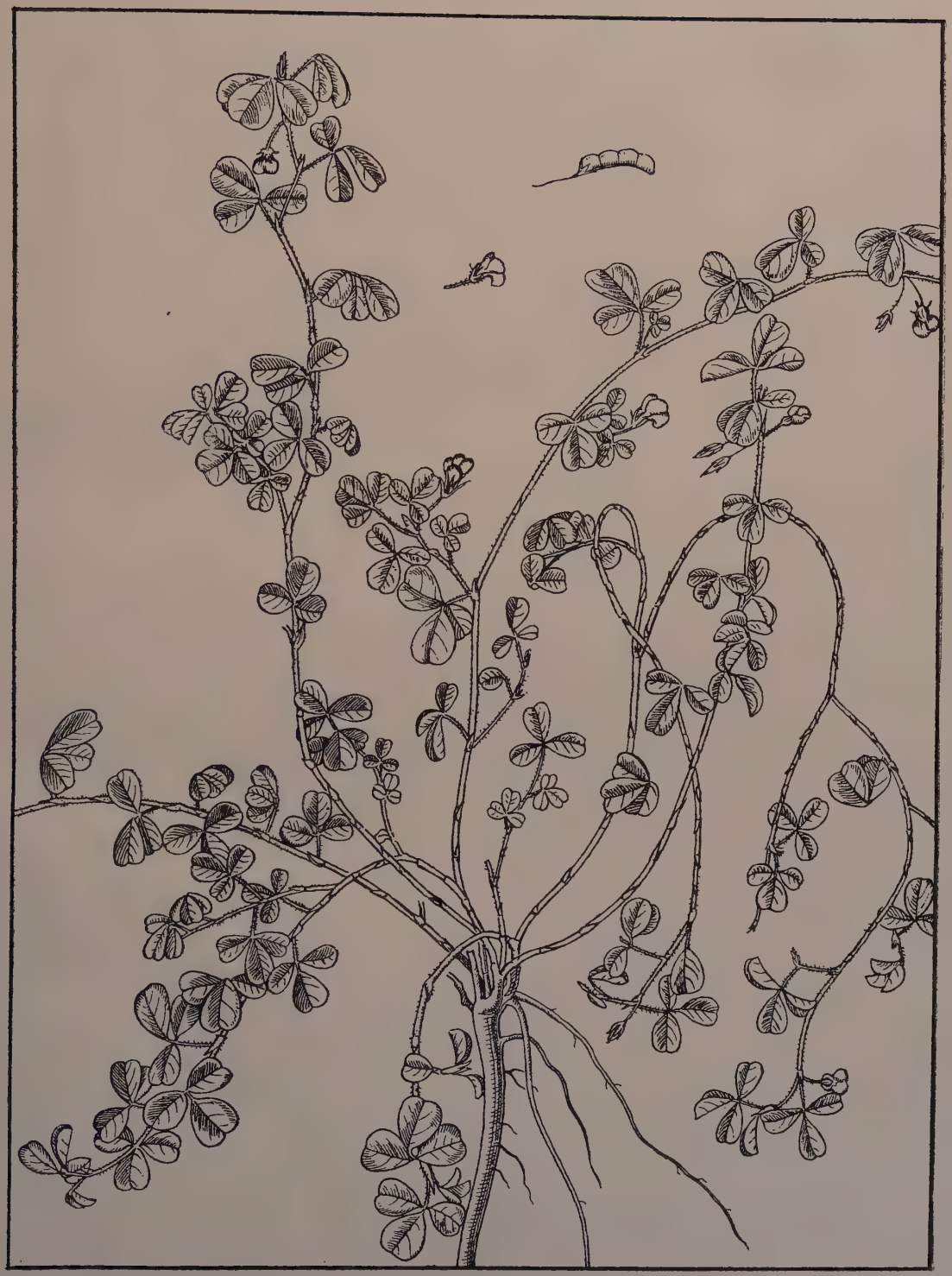

Plate I.—DESMODIUM TRIFLORUM.

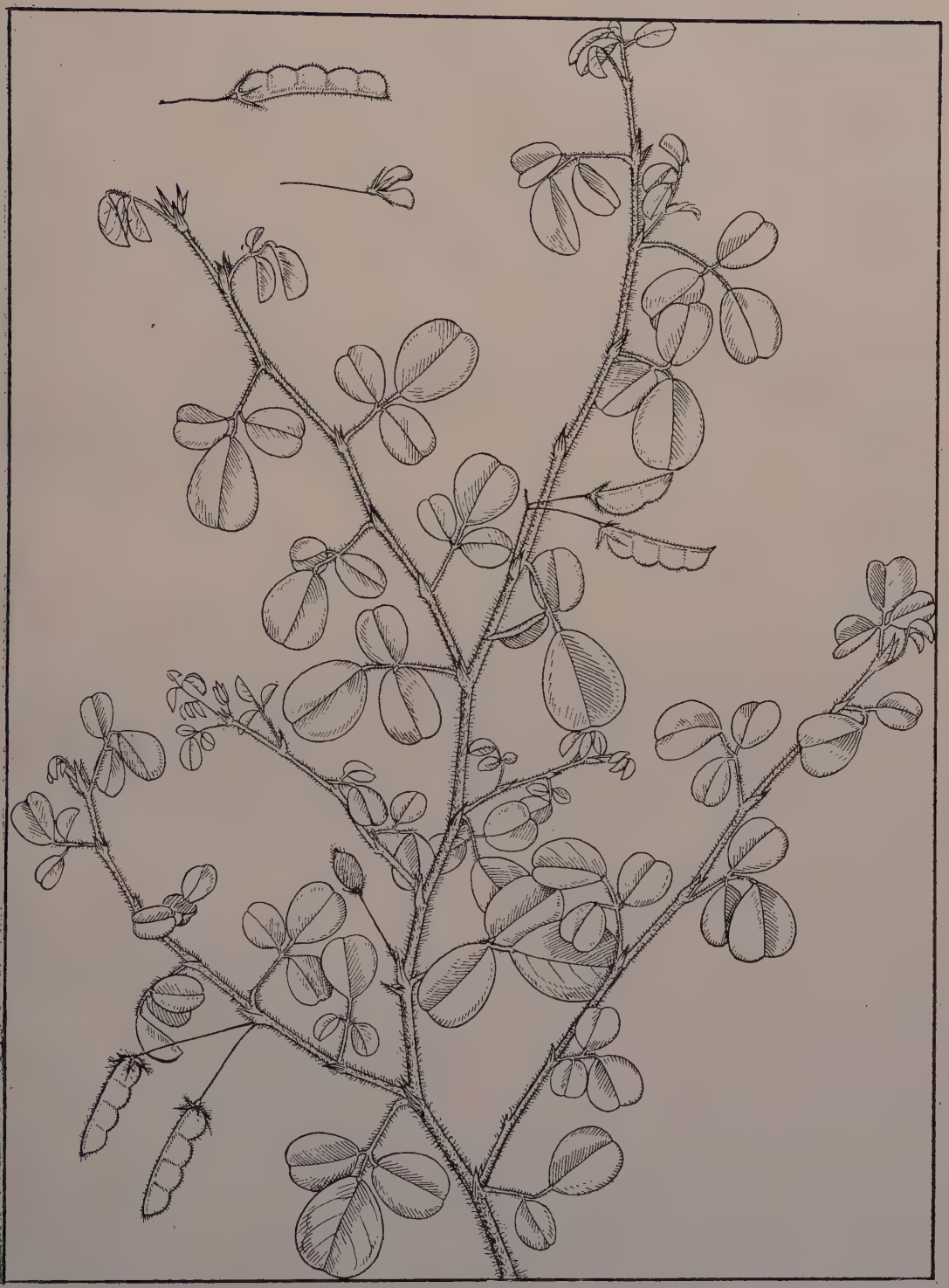

Plate II.—DESMODIUM HETEROPHYLLUM.

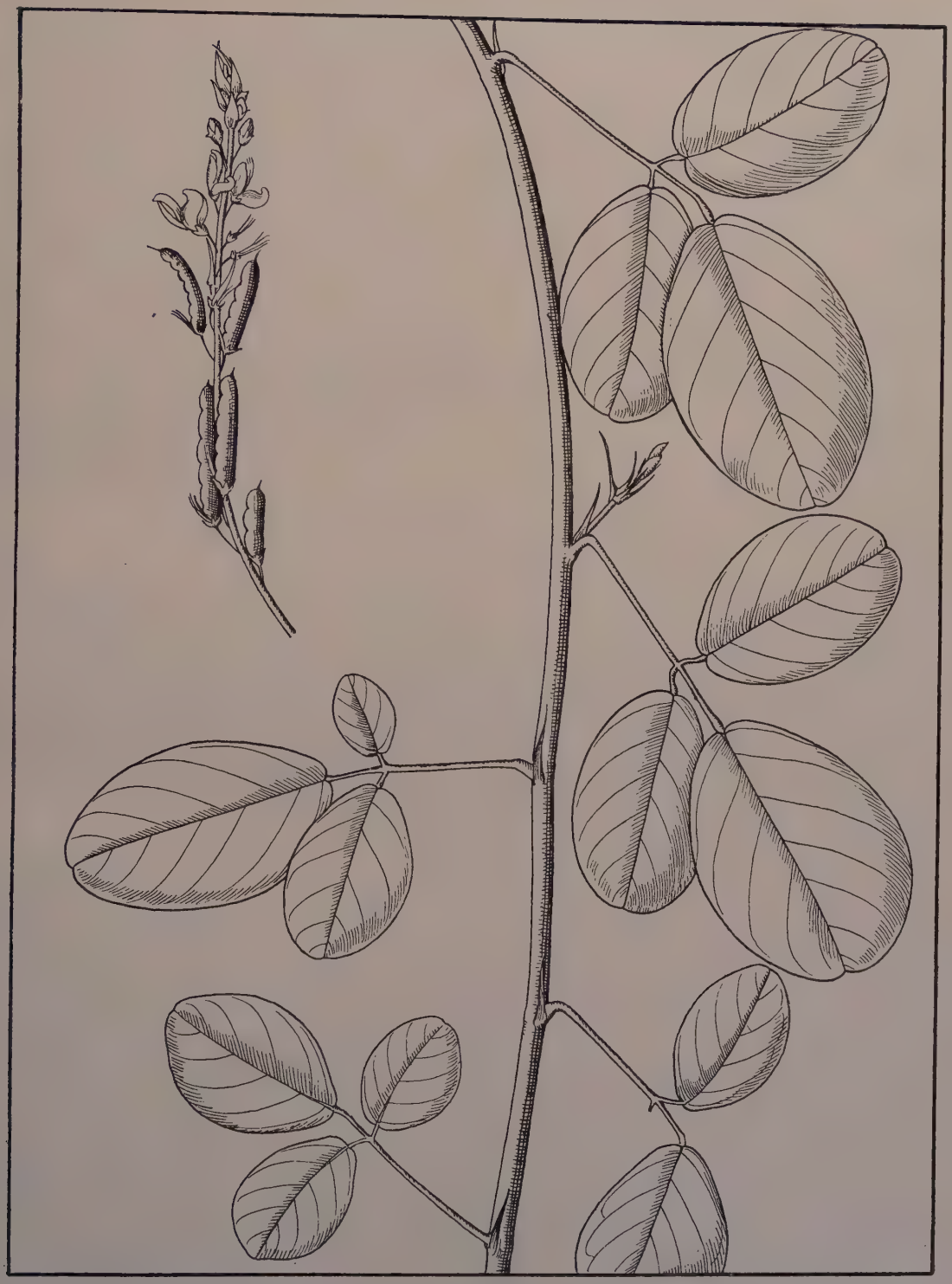

Plate III.—DESMODIUM HETEROCARPUM.

difference in the sizes of the leaflets. The leaflets are one half to one inch long, and in some examples they have a pale or glaucous area along the middle. The flowers are like those of *Desmodium triflorum*, purple, small, two to four together on slender stalks. The pod has three to six joints. This plant is very common in the low-country, and up to 2,000 ft. It frequently grows among grass. Like the last, it is used in the treatment of fevers.

Desmodium heterocarpum DC. (Plate III, natural size). This is known to the Sinhalese as Et-undupiyali. Eta means seeds, and in this species the seed pods are clustered in a mass at the top of the stem, and are therefore conspicuous. It is a larger plant than the previous two, and consequently it has not been possible to include the whole plant on the plate, it being considered preferable to show the leaves full size rather than to reduce the figure to a smaller scale. The plant is perennial, with a woody stem which may reach a height of 2 ft. It is sub-erect, rooting at the nodes below, but curving upwards and becoming more or less vertical. The flower is usually purple, but sometimes pale yellow or white. The pods are about an inch long, grouped together in dense spikes and usually five to seven jointed. The plant was named *heterocarpum*, because on the first specimens sent from Ceylon some of the lower pods had only one joint. That, however, is exceptional. It is very common in the wet low-country, and occurs up to an elevation of 4,000 ft.

The foregoing species of *Desmodium* are chiefly low-country plants, or flourish best below 2,000 ft. Another small species is common on patana land at 5,000-7,000 ft. This is *Desmodium parvifolium*. The leaflets are about the size of those of *Desmodium triflorum*, the terminal leaflet being larger than the other two. But they are usually a paler green and appear more tender. Its habit is different from that of *Desmodium triflorum*. It forms a small shrubby growth, and from this slender branches trail to a great length. The flowers are bright pink, very small, in spreading spikes. It is distinguished from the previous species by its pods. In this species, the pod is indented on both sides, whereas in the former, the pod is indented only on one side. Further, the joints of the pod of *Desmodium parvifolium* open on one side when ripe; the joints of the pods of the other three species do not open. As this is an up-country plant it has no Sinhalese name.

At the present moment, cover plants for low-country are better known than for up-country estates. The majority of the introduced leguminous plants are more suitable for low or mid-country estates ; and as the flora of the low-country districts has not been exterminated to the same extent as up-country, possible cover plants can be suggested more readily. Investigations are now being made in the up-country tea districts to ascertain what local plants are available there.

PESTS AND DISEASES.

WEEDS.

The following notes are taken from a paper on the General Characters of some Philippine Weed Seeds by E. QUISUMBING, in the PHILIPPINE AGRICULTURAL REVIEW, Vol. XVI, No. 4.

A weed may be defined in different ways. Many call it "a plant out of place," while others call it "a wild plant that has the habit of intruding where not desired." CLARK & FLETCHER* define it as "any injurious, troublesome, or unsightly plant that is at the same time useless or comparatively so."

CLASSIFICATION OF WEEDS.

Before we can control or eradicate weeds successfully, it is necessary to know the kind of weeds we have to deal with, their characters, habits of rowth, life history, and various other things. Commonly speaking, we have two kinds, water weeds and terrestrial weeds. Of these weeds, the latter are the worst enemy of the farmers and the most abundant. Of the water weeds, water hyacinth, *Eichhornia crassipes* is the most pernicious. Formerly it was cultivated as an ornamental plant, but through neglect has run wild, and once it gains a foothold in the navigable rivers and lakes it is a most serious problem to check its growth. The water hyacinth is spreading rapidly in the Philippines and is very common along the shores of Laguna de Bay and in the Pasig River, and in some places threatens to halt navigation. Unless measures are promptly taken for its immediate eradication it will soon be impossible to exterminate it except at enormous cost. This particular weed has caused the United States government heavy expense at various times.

The terrestrial weeds may be further classified in various ways but probably the best scheme is by duration of life. They are either annuals, biennials, or perennials.

Annuals live for only one year, maturing their seeds and then dying. If proper cultural measures are adopted the annuals are the easiest to control. Only a knowledge of their seeding season is essential and necessary for such control. *Portulaca oleracea*, and *Hyptis suaveolens* are examples of these.

Biennials live practically for two years, the first year being given to the vegetative growth and the second to reproduction. There are comparatively few biennials. Some bear seeds in the second year but later turn into perennials.

Perennials are the most abundant and are the worst of all the weeds. They produce great quantities of seeds throughout most of the year, and also may reproduce by vegetative multiplication. The latter is accomplished by the presence of runners or rhizomes.

* *Farm Weeds of Canada*, Ottawa Department of Agriculture, pp. 103 pls. 56, 1906.

INTRODUCTION, ORIGIN, AND GEOGRAPHIC DISTRIBUTION OF WEEDS.

The history of the introduction of weeds to the Philippines and their origin is an interesting one in many respects. It is, indeed, rather astonishing to find that most of our weeds are of foreign origin and surprising too that most of them are of American origin.

Table 1 gives a summary of species considered in this paper; a total of 59 species, distributed through 43 genera, and 16 families. Of these 59 species none are endemic. All have been introduced either purposely or accidentally. Of the former there are considered 10 species, two being doubtful, and of the latter 49 species. Of the 59 species, two are cultivated to some extent, one occasionally cultivated, and 56 are spontaneous.

Long before the Philippine Islands were discovered by the Spaniards, the Archipelago was inhabited by people whose exact origin and time of arrival are not well known. And it is rather likely that these early invaders and settlers were the first to introduce cultivated plants in to the Philippines, and from the geographical location of the Islands, it may be inferred that most of these plants came from Malay Archipelago, and only a few from the mainland of Asia. With the discovery of the Philippines in 1521 by the Spaniards another period began in which communication was started with tropical America. From this date up to the year 1815 the Archipelago was ruled as a dependency of Mexico. Communication between Mexico and the Philippines was maintained by means of the state galleons, which sailed annually for Manila, first from Navidad and later from Acapulco. These galleons carried passengers and large quantities of merchandise; unquestionably on these ships many weed seeds of American origin were brought in accidentally in packing materials as "stowaways." During the early days of Spanish occupation many economic plants were brought in by government officials and priests,—abaca (*Musa textilis*), trees yielding resins, timber, gums, etc., and a few palms, some bamboos, and some rattans being among the exceptions. Of course with these plants many weed seeds came in accidentally. Of the ornamentals and plants for medicinal purposes some have gone astray and become weeds. Among these *Argemone mexicana*, *Mimosa pudica, Indigofera suffruticosa*, *Cosmos caudatus*, and *Celosia argentea*, are notable examples.

While a great deal has been published on the origin of weeds, comparatively little has been written with regard to the origin of Philippine weeds. To determine the origin of these is no simple task. In many cases there are only vague indications. The evidence from botanical literature is important, but is not sure proof, as a plant may have been described first in Asia, and yet its nativity may not be there. From Table 1, it will be found that five species are from Mexico; nine originated from tropical America, excluding those enumerated for Mexico; two native of the Mediterranean region; one from Brazil; three of American origin; two from the Old World; two from India; seven are of Oriental or European origin; and twenty-eight have unknown or doubtful origin.

DISSEMINATION.

The ways in which weeds are distributed and scattered are very important factors in control measures.

(1) *By Wind.*—The weed seeds scattered by wind are usually provided with special structures. Some have wings, or coma of hair, or hair-like parachutes, and others are light or small enough to be carried easily by wind though not for great distances. Cogon, talahib, and many of the family Gramineæ, Asclepiadaceæ, and Compositæ furnish examples of wind dissemination.

(2) *By Water.*—A number of our troublesome weeds are transported by water either in ocean currents, creeks, rivers, or irrigation ditches.

(3) *By Animals.*—In this manner of dissemination horses, cattle, carabaos, and other ruminants, and hogs, and dogs play an important role. Seeds are carried in their feet, in the hair and coats, and in some cases pass undigested with the dung. Live-stock is commonly responsible for the spread of weed seed from town to town and from one farm to the other. The weeds scattered by animals are often characterized by the presence of a mucilaginous substance on the coats of the nutlets which expands and becomes gummy and sticky when moistened and thus the seeds adhere to the animal's body. Other seeds are provided with hooks, clawed appendages, or spines.

(4) *By Man.*—So far man is one of the most effective and the most rapid agencies in the dispersion of weed seeds. There are several ways by which he disseminates the seeds. (*a*) Walking from field to field in a dewy morning he is apt to carry lots of *Paspalum* spp. and *Hyptis* seeds after the manner of the animals mentioned above. They stick to the clothing and shoes and are dropped when the clothes and shoes get dry. (*b*) Other weed seeds are introduced with nursery stock. (*c*) Many weed seeds are mixed with commercial seeds. (*d*) Many are scattered in the fields with manure. (*e*) A large number are carried and dropped on farms and in towns by means of vehicles, farm implements, and machinery. (*f*) By steamships and railways, they are carried with merchandise.

The following weeds have been inadvertently introduced into the Philippines by man: *Malachra capitata*, *Cassia tora*, *Cassia occidentalis*, *Celosia argentea*, *Paspalum* spp., *Triumfetta semitriloba*, *Jussiaea linifolia*, *Hyptis suaveolens*, *Ageratum conyzoides*, *Elephantopus* spp., *Synedrella nodiflora*, *Panicum flavidum*, *Achyranthes aspera*, *Sesbania cannabina*, *Abutilon indicum* and *Leucas* spp. Those introduced by man either for medicine or for ornamental purposes and which have become weeds are: *Indigofera suffruticosa* for dye; *Mimosa pudica*, *Cosmos caudatus*, *Argemone mexicana*, *Celosia argentea*, and *Malachra capitata*.

(5) *By Birds.*—Migratory birds spread weed seeds, but they also form a factor in the eradication of the weeds as some depend almost entirely for their food on weed seeds.

(6) *By the Plants themselves.*—Some weeds have fruits with an explosive or ejecting mechanism. Seeds belonging to this category travel only comparatively short distances. The most troublesome weeds are spread by means of runners and rhizomes.

PREVALENCE AND DOMINANCE OF WEEDS

The prevalence of weeds according to SHAW* depends upon two factors: "(1) On the number of weed species in any locality and (2) on the extent to

* *Weeds and how to eradicate them*, ST. PAUL, 210 pp, figs. 22, 1896.

which these various species are allowed to multiply." The extent to which certain troublesome weeds have been allowed to multiply in the Philippines is simply alarming. While some are found only occasionally in the fields, others dominate the locality. This is notably true of *Imperata* spp., *Saccharum spontaneum*, *Andropogon halepensis*, *Ageratum conyzoides*, *Indigofera* spp. Some of these grow so rapidly, that in consequence the cultivation of the land has to be abandoned. They thrive in all fields, crowd every crop, invade gardens, and occupy sides of the roads, often covering the entire road.

The pantropic weeds which form the bulk of the weed flora present in the Philippines remain persistent and are dominant for various reasons. MERRILL* believes that the dominance is probably due to fundamental differences in the aboriginal floristic conditions. Also they become easily naturalized and have scattered themselves extensively throughout the Archipelago. These weeds are the most difficult to eradicate as many of them have established themselves firmly. To many of these weeds which are drought intolerant, drought is the only check. The rains are responsible for the prevalence and continuous bother of the weeds on the farms and elsewhere. Seeds usually fall off during the drier months and new plants reappear immediately on the arrival of the rainy season. Consequently it is during this season that the weeds are most noxious and troublesome to the farmers. Some weeds like *Andropogon halepensis* var. *propinquus*, *Saccharum spontaneum* and *Imperata* spp. and others belonging to the family Gramineae have deep penetrating root systems with enormous and hardy runners and rhizomes. Shallow ploughing cannot kill them and burning which is employed extensively is merely a stimulus to multiplication. Most of our tropical weeds and a few of the pantropic ones owe their dominance largely to the fact that throughout all the year they are continuously developing and maturing seeds. This is a decided advantage in the struggle for existence over the native species which have a restricted period of anthesis.

The viability of weed seeds varies a great deal. Some are susceptible and are easily destroyed in composted manures. Many die through exposure to direct sunlight. Others, however, which have been buried deep in the soil remain viable for some time. These seeds if brought to the surface by ploughing germinate in the presence of moisture. In upland fields, caingins and banana plantations, weediness is due to fallowing, neglect of the land, or improper cultivation. Many seeds which remain in the ground, retain their vitality for years. In the United States experiments have been conducted to determine the vitality of seeds which give astonishing figures. It was found that some seeds retain their vitality after being buried in the soil for fifteen years, and still others remain vital and will germinate after having been buried for twenty-five years.

Another reason for the predominance of weeds on the farm and elsewhere is the natural tendency of some weeds to produce enormous quantity of seeds at one season. Finally weeds abound and are a menace to farmers because they give no serious attention to eradicating them or carrying out systematic methods for their control.

SOME SMALL BENEFITS OF WEEDS

While weeds are generally considered as useless and troublesome there are a few which render some benefits, but too small to justify their cultivation.

* *The Flora of Manila.* Bureau of Science, Manila, 490 pp, 1912.

(1) The presence of weeds keeps the farmers at work thus inducing more frequent and thorough cultivation. In some cases, however, the abandonment of farms is attributed to the presence and havoc of weeds.

(2) Some weeds, especially those that are succulent, are used as human food and as feed for animals. *Gulasiman* and *uray* are used by man as salad. As forage, cogon, talahib, agingay, Bermuda grass, *Desmodium* spp. and gulasiman are the most notable.

(3) Some weeds yield bast fibres which are used in the manufacture of sacks; other fibres that may be used as substitutes for jute. *Corchorus* spp., *Sida acuta*, *Urena lobata*. *Triumfetta* spp. and *Malachra capitata* are examples of the fibre producing weeds.

(4) Some weeds have useful medicinal properties. *Abutilon indicum*, *Tinospora crispa*, and *Cassia alata* are examples. Many weeds are used by the native herb doctors.

(5) The essential oils from some weeds are sometimes used to adulterate perfumes. *Lantana camara*, *Hyptis suaveolens*, and many more belonging to the family Labiatæ, are thus used.

(6) Weeds retain moisture and fertility of the soil, in some cases by shading the ground which has been abandoned. They also prevent erosion. The fertility of the soil is undoubtedly increased if leguminous weeds grow in it.

DISADVANTAGES AND LOSSES DUE TO WEEDS.

(1) Weeds form the chief crop in the Philippines. This is not generally known, but nevertheless, it is true. It is impossible to say what labour, time, and money are wasted and consumed in futile efforts to keep weeds down. Ordinary cultivation in the Philippines is really a continuous battle with the weeds, which in some cases win and the farmers leave their farms. Some native farmers "fallow" their land as an excuse; but they really surrender to the weeds. This practice is wide-spread in the Philippines and is detrimental because this "year rest" gives the weeds a splendid opportunity to multiply rapidly. The year following the rest, when he returns to his land, the poor farmer confronts once more his old task now intensified, of battling with the weeds.

(2) *Aeginetia indica* Roxb. (Family Orobanchaceæ), is one of the worst weeds in sugar-cane plantations. It is parasitic on the roots of the cane plant, and not only affects the well-being of the plant but also reduces the sugar content of the stem, which is an important factor in the sugar industry.

(3) Weeds which intrude themselves in between cultivated plants rob these plants of nutriment. Besides this, they also deprive the plants of a portion of their moisture and sunlight and thus decrease the yield.

(4) Some weeds serve as hosts for certain injurious and destructive insects and fungi. The failure to control and drive out these pests from the farm is due in some cases to weeds. This is true in the case of a hemipterous insect (*Leptocorisa acuta* Thunberg) which affects and attacks the rice during the milky stage of the grains. Also when certain crops are harvested the attacking insects live on various weed plants near by and come again on the next cultivated crop. A knowledge of these

particular weeds is necessary for the control of such insect parasites. The injurious cacao borer works this way. This borer is said to feed on certain wild sterculiaceous plants at first, later turning to the cacao. The same conditions are present with some fungus diseases. The downy mildew of corn, *Sclerospora maydis*, is said to be harboured on some wild grasses as well as by corn. WESTON* found various grasses bearing this fungus. It is very probable that it spends part of its life on some of these grasses when the corn is out of season. The rust on wheat, *Puccinia graminis*, is the best and the most classical example of finding weeds hosts. This fungus lives on the wheat at one season and continues its life on barberry for the other.

(5) Weeds spoil the appearance of a farm and render it less valuable. The statement requires no further explanation. Land foul with weeds sells for less than land clean of weeds.

(6) Some weeds are poisonous, causing the death of animals in pastures and frequently causing colic and digestive troubles.

(7) Some weeds render the milk valueless by an offensive smell.

(8) Some weeds render certain products of the farm unmarketable and reduce their price. This is especially true with *zacate* weeds.

(9) In the case of water weeds many lakes and rivers become choked with them. *Eichhornia crassipes*, water hyacinth, is the best example of these.

GENERAL PRINCIPLES FOR THE VARIOUS METHODS OF CONTROL AND ERADICATION OF WEEDS.

(1) Prevention is far cheaper than cure; the introduction of weeds into farms should be prevented so far as possible.

(2) Prevent weeds from seeding on the farm. This is the most important control measure. Mowing, cutting, or pulling up the weeds before they flower or fruit, are effective.

(3) Crop rotation that kills weeds should be encouraged.

(4) Crops should be cultivated throughout the year.

(5) Do not leave any vacant lot in or near your farm uncleaned. Besides giving a chance for the weeds to grow, such a lot makes the place suitable for hosts of insects and fungi.

(6) Pulling up with the hand or digging them up with weeders will rid a lawn of weeds.

(7) Weeds which are already in seed should be cut off and burned.

(8) Deep ploughing may be practised. This will bury the seeds deeper; and some seeds lose their vitality when buried deeper in the soil. Deep ploughing for this purpose should be followed by fallowing.

(9) Turning land to pasture is also an effective means of combating some noxious weeds.

(10) In general, a weed law is desirable. There is no such law in the Philippines and one should be enacted. Such a law should make weeding co-operative and effective, as it is in the United States and other countries, and provide penalties for allowing lands to become foul with weeds and thus serve as sources of weed invasions.

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* Philippine Downy Mildew of Maize.—JOURNAL OF AGRICULTURAL RESEARCH 19: 97—122, 1920.

(11) Control of weeds by chemical means. No experiments along this line have been conducted yet in the Philippines.

(12) Burning lands infested with weeds has certain limitations and should be used cautiously. Burning "cogon lands" and "talahib patches" tends to stimulate the multiplication of the plants.

(13) All weeds should be removed from the fields, carried away, and not allowed to grow. The common practice of cutting *gulasiman* and allowing it to stay in the fields merely induces rapid multiplication.

(14) Plant clean seeds only.

(15) Above all, the careful study of the habits of growth, life history, and methods of propagation is a most important factor in weed eradication.

SOAP AS AN EFFECTIVE CONTACT INSECTICIDE FOR THE PHILIPPINE MIGRATORY LOCUST.

FAUSTINO Q. OTANES.

With the exception of the ordinary methods, like driving the hoppers into pits and catching the fliers with nets, no other method of combating locusts has been used in the Philippines more than spraying with contact insecticides. In some places in the country crude oil and kerosene have been tried especially on hoppers. Pure crude oil and kerosene are undoubtedly effective, but the objection to their use is the expense. For this reason JONES & MACKIE, formerly entomologists of the Bureau of Agriculture, recommended ordinary kerosene emulsion, with the statement that "even very dilute mixtures are effective against the very young hoppers." Tests made by the writer, however, with this emulsion, the dilutions used being 1 to 10 and to 6 (the stock solution was made according to the formula: kerosene, 7·5 liters; soap, 400 grams; water, 4 liters), showed that it is not effective. Hoppers of the first stage or instar were sprayed with the solutions as liberally as possible to insure thorough wetting. While with the stronger solution, 1 to 6, about fifty per cent. of the hoppers were drugged and apparently killed, yet most of them revived and were as voracious as ever. Only about 8 per cent. of the hoppers died from the effects of the solution. Another solution, which is essentially kerosene emulsion consisting of caustic soda, resin, kerosene, and water, and which is comparatively cheap, has been found by MR. ARSENIO GOCO, Supervising Locust Inspector of the Bureau of Agricuture, to be deadly to both hoppers and fliers, partly because of the resin, which is poisonous to insects. This solution has been used with considerable success in several places in the Philippines. One great trouble with this spray is that the resin and caustic soda are not available in most places in the Islands, and the expense and inconvenience of their transportation from a distributing centre, like Manila, to where they are needed is an item which cannot be overlooked. The solution, however, should be used whenever the materials are available and wherever they can be easily transported.

Bearing in mind the enormous areas covered by locusts during an outbreak, simpler and less expensive sprays (everything considered as availability, ease of preparation and cost) are certainly to be desired. With this

in mind the writer conducted tests with several substances at the Singalong Experiment Station in June, 1923, when there was again a bad locust outbreak as in the preceding year. Soap was one of the substances tested.

It is a matter of common knowledge, especially among entomologists, that soap is of value as an insecticide and is commonly used in other countries for soft-bodied insects, as plant lice or aphids, and is effective. Soap was among the first remedies employed against insects; it kills by contact, that is it clogs up the breathing pores or spiracles, thus suffocating the insects. While soap is commonly employed in other countries for soft-bodied insects like aphids, yet very seldom, if ever, has it been used alone for such a formidable pest as the locust. In the Philippines the writer is unaware that it was ever used to spray locusts before he tried it. That soap was never thought of as a locusticide may be because of its harmlessness on the human skin, unless of course when used excessively. And yet, in properly prepared solutions, it is so deadly, killing the locusts in a few minutes. The efficacy of soap as a contact insecticide for locusts as well as for other insects, lies in part in the fact that it has a very low surface tension and for this reason spreads very rapidly on the bodies of the insects and gives them a complete wetting, penetrating most, if not all, of the breathing pores and clogging them up and perhaps irritating the tracheæ or respiratory tubes.

LABORATORY AND FIELD TESTS.

In the writer's test at the Singalong Experiment Station white, hard, Chinese laundry soap, ordinarily sold in blocks, was used. One block of this soap, weighing approximately 150 grams, was dissolved in five liters of water. It was sliced and the slices were wrapped in cheese cloth and the whole was rubbed and squeezed by hand until all the soap was dissolved. The soap may be also dissolved in boiling water. Hoppers of the third and fourth stages or instars, but mostly of the latter, were sprayed. The method of testing consisted in releasing a number of hoppers in the grass and then spraying them with a bucket pump provided with a disk nozzle, which delivered the soap solution upon the hoppers in a fine mist. It was found that the solution acted very quickly upon the hoppers as the insects began to succumb in less than a minute after spraying. Most of them, however, succumbed six minutes after spraying, and the last hoppers after eight minutes. The hoppers were picked up as they succumbed and spread on paper and then placed in wire cages for observation. In one of these tests, in which 60 hoppers were used, 9 hoppers or 15 per cent. of the entire number revived, but it was found that these remained sick and died afterwards, although they were supplied fresh grass every day.

It soon became urgent, owing to the bad locust outbreak during the year 1923 that extensive field tests should be made in order that, if found effective under field conditions, soap solution might be recommended to help remedy the situation. The presence of large number of hoppers in the vicinity of Manila furnished the opportunity for such extensive field tests without much trouble in transporting equipment and materials.

On July 3, 1923, the writer in company with MR. GONZALO MERINO, Chief of the Plant Pests Control Division, Bureau of Agriculture and COLONEL AURELIO RAMOS of the Philippine Constabulary and a member of the

Insular Locust Committee, went to San Pedro, Macate, one of the towns near Manila infested by hoppers. The hoppers at San Pedro were in the fourth instar. Two blocks of hard, white Chinese soap, each weighing approximately 150 grams, were dissolved in 13 liters of water at the rate of 0·6 kilo per 20 liters of water or approximately one petroleum canful of water. The soap used in one petroleum canful of water cost 16 centavos, or 0·8 centavo per liter. A bucket pump with a disk type of nozzle was used in spraying. This solution was not effective in the field; very few hoppers were killed and some of these revived.

On July 5, the writer went to Fort McKinley again where hoppers were abundant, this time with MR. ANGEL ARGUELLES and MR. W. SCHULTZE, chemist and entomologist of the Bureau of Science, respectively. Hard, white Chinese soap at the rate of 0·9 kilo per 20 liters at a cost of 24 centavos was used. This too was not found effective. Only a small number of the locusts were killed.

The next day, July 6, the writer went out again to Fort McKinley in company with COLONEL RAMOS. At this time soap in the proportion of 1·2 kilos for 20 liters at a cost of 32 centavos, was tried. Pumps provided with rubber hoses about 10 meters long and with Vermorel nozzles were used. Better results were obtained with this solution, as was expected, as it was stronger. It was estimated that about 70 per cent. of the locusts sprayed, were killed.

On July 7, the writer went out again with COLONEL RAMOS to Fort McKinley. This time soft yellow Chinese soap was used at the rate of 0·3 kilo in 10 liters at a cost of 0·9 centavo per liter. The test was made right on the grass in the open so that the effect of the spray could be easily observed. All of the hoppers that were wet with the solution began to succumb in about 1 minute and all succumbed in less than 4 minutes. Thus this solution was found more effective than the white soap at the rate of 1·2 kilos per 20 liters and yet cheaper than the latter.

Further tests made near Fort McKinley on July 9, 1923, by the Director of Agriculture, the Chief of the Plant Pests Control Division, and the writer, confirmed the results obtained on July 7, so that there remained no doubt as to the effectiveness of the yellow soap as a locusticide. Accordingly it was decided to use it as a spray at Fort McKinley, which was then heavily infested by hoppers. Yellow soap at the rate of 0·5 kilo per 20 liters of water was used and the spray was applied with bucket pumps, each with a rubber hose about 10 meters long and a Bordeaux nozzle. This nozzle was found excellent because it gives a fan-shape spray and consequently more hoppers can be sprayed. Hundreds of soldiers were then being used in combating the locusts by the ordinary driving and pit methods. The solution was found especially valuable in killing the hoppers congregated in the bushes and shrubs, which made it difficult for the men to drive the hoppers. The officers and soldiers who saw the spraying expressed satisfaction at the effectiveness of the soap. Later EX-GOVERNOR EULOGIO RODRIGUEZ of Rizal, then Mayor of the City of Manila, who himself was in the field directing the campaign throughout in co-operation with the military had soap purchased and ordered his inspectors to use it at Fort McKinley and in other places in Rizal Province infested by locusts.

On July 11, by order of the Director of Agriculture, telegrams were sent to all locust inspectors of the Bureau of Agriculture instructing them to use soap as a spray at the rate of from 0·4 kilo to 1 kilo to about 20 liters of water. Later, on July 16, the writer prepared the following circular, copies of which were sent to all inspectors and other people engaged in the fight against the locusts:

BUREAU OF AGRICULTURE, CIRCULAR No. 138.

Ordinary laundry soap dissolved in water has been found by this office to be deadly contact poison to locusts; it clogs up the breathing pores or spiracles and thus kills them in a few minutes. Inspectors of the Bureau of Agriculture are therefore advised to use it and recommend it to all engaged in locust control work.

Kind and Amount of Soap to use.

The soft yellow or wax-coloured Chinese laundry soap should be dissolved in one petroleum canful water (approximately 20 liters). Put the soap cut into small bits into a cloth bag strong enough to stand pressure—coarse abaca cloth has been found good—and squeeze or rub it until dissolved.*

How and When to Spray.

Much of the success with any spray solution depends on the appliances used and the thoroughness of and the time of application. In spraying locusts, a bucket pump is good, with about 10 meters of rubber hose and a nozzle which will deliver the liquid upon the hoppers in a fine mist. The Bordeaux type of nozzle is excellent, but other types of nozzles, such as the Vermorel, will do.

Care should be taken that the hoppers are thoroughly wet with the solution, as it should be kept in mind that the insect has eighteen breathing pores or spiracles, nine on each side of the body, and the soap solution must enter all the pores, and penetrate the breathing tubes or tracheæ and clog them up completely so the hoppers will die from suffocation. The best time to spray is in the evening and early in the morning when the hoppers are all together.

Advantages of Soap as a Locusticide.

Soap as a locusticide has several advantages, among which are as follows:—

(1) It is cheap. One-half kilo of soft Chinese soap dissolved in 20 liters of water has been found sufficient to kill hoppers of the fifth stage or instar and all other active stages at a cost of only 16 centavos per 20 liters and this can be reduced if the soap is bought wholesale.

(2) Soap is sold everywhere.

(3) The solution is easy to prepare.

(4) Unlike certain other insecticides recommended for locusts it is not poisonous to man, domestic animals and birds.

Field inspectors who used the soap soon reported to the Bureau encouraging results of their spraying, MR. ALEX. A. BEACON, Locust Inspector stationed in Negros, wrote: "The solution (soap solution) as per telegram

*If firewood can be easily obtained in the field the soap may be disolved in hot water.

received from the Director of Agriculture, was tried on the Hacienda Concepcion, of the Municipality of Murcia, and it was found to kill the hoppers of the first and second stages almost instantly. MR. and MRS VALERIANO GATUSLA, and many of the workers witnessed the use of the said solution on the hacienda on July 13, 1923. Another inspector, D. M. PASCUAL, in Rizal, wrote as follows: "We are glad to report the tremendous success we obtained with the soap solution in killing hoppers." Other inspectors in Bulacan reported that the soap solution was found effective on fliers as well as on hoppers, thus confirming the results obtained in the laboratory.

MR. ANTONIO C. TORRES, Locust Inspector for Tayabas and Laguna, also reported that soap was used under his direction in those provinces during August and September, 1923, and the people who saw the results of the spraying were very much impressed with the effectiveness of the soap

The statement has come from various sources that hoppers sprayed with soap solution revive sooner or later after the soap has dried off This all depends upon the kind of soap and the concentration of the solution. As our tests have shown the hard white soap, while found effective in the laboratory, was not found so in the field except in concentrated amounts, in which case the cost of spraying would be high. The soft soaps in general, such as the yellow Chinese soap are more effective in comparatively less amounts and thus cheaper. The right concentration of the solution, as is true with other insecticides, however effective they are, must always be borne in mind if the best results are to be obtained. The writer has found that dilute solutions of the yellow Chinese soap are not effective. This is why less than 0·4 kilo of soap in 20 liters of water is not recommended even for the youngest hoppers.

Success with the soap also depends, as has been said elsewhere, upon the spray pumps used. Nozzles which give a fine mist are to be preferred, for the waste is reduced to the minimum, more hoppers can be sprayed and the insects get a more thorough wetting.

Summary.

Ordinary laundry soap has been found an effective contact insecticide for the Philippine migratory locust, killing the insect in a few minutes. Soft soaps, as the ordinary yellow Chinese soap, are more effective than the hard soaps. A half kilo of soft Chinese soap dissolved in 20 liters of water has been found sufficient to kill fliers as well as hoppers of all stages.

Soap solutions have a very low surface tension and consequently spread very rapidly. This accounts partly for their effectiveness as sprays for locusts as well as for other insects.

Recommendation.

For spraying, the soap solution is so far the most effective and cheapest remedy found for locust control. Each municipality should equip itself with a number of bucket spray pumps with 10 meters or longer rubber hoses and Bordeaux and Vermorel nozzles.—PHILIPPINE AGRICULTURAL REVIEW, Vol. XVI. No. 4.

THE COCONUT BUD-ROT IN PORTO RICO.

C. M. TUCKER.

Throughout most of the coconut producing lands of the world the most serious disease attacking the trees is the bud-rot. In different countries the disease assumes varied symptoms and is caused by different organisms, bacteria or fungi, The bud-rot has caused serious losses in the Philippine Islands, India, Malabar, Ceylon, Cuba, Trinidad, Jamaica and other countries. One of the most severe outbreaks occurred in Cuba, where the disease was studied and ascribed to bacteria.

In Porto Rico the coconut palm has been comparatively free from serious diseases. In 1912, G. L. Fawcett, plant pathologist at this station, studied some isolated cases of bud-rot. In the section where he found a few diseased palms the disease has now spread until twenty-five per cent. of the trees have died.

A survey has recently been made along the western coast between Mayaguez and the Rincon point to determine the incidence and severity of the disease. About 600 diseased trees have been found. The most badly affected regions appear to be along the beach at Mayaguez and on a farm north of the Añasco River. In each case about 25 per cent. of the trees have been killed. In the Mayaguez section the disease seems to have appeared about 1911 and to have spread rather slowly, while in the farm near the Añasco River it is said to have been first seen in 1918 and to have spread rapidly in 1922 and 1923. The number of diseased trees as shown by the survey is not a true index of the damage the disease has done, as no attempt was made to determine the cause of the death of numerous trees which had been cut down, most of which probably died from bud-rot.

The first visible symptom of the disease is the yellowish brown color of the young emerging leaf. The color is a light, bleached brown, as might be expected following the death of a leaf in which the chlorophyll, or green coloring matter is not yet developed. A section through the bud at this stage shows the young leaf bases and the growing point to be involved in a soft, watery, ill-smelling rot. The young swords are rotted in the same manner. The dead leaf may be pulled out of the inclosing leaf sheaths. If the diseased palm is allowed to stand the leaf is soon broken by the wind and hangs tip downward between the older leaves, finally breaking off and falling to the ground. The older leaves may remain green and retain their normal position for several months. As the older leaves fall and no new ones emerge the tree soon has a crown of horizontal leaves which gradually fall away leaving the bare trunk.

The infection does not extend to the nuts, and those which have reached a diameter of 3-4 inches when the tree becomes diseased will usually hang on the tree until they mature or until their supporting leaves fall; the latter usually occurs before the nuts have time to mature. Young racemes are often dead when the sheath opens, being invaded and rotted at the base.

The leaves of infected trees sometimes have rows of dark brown spots extending across the pinnæ. These spots are due to an infection which occurred in the bud where the pinnæ were pressed together. We have

not established any connection between these spots and the disease. In the majority of infected trees they are not present. Occasionally they are found on the older leaves, and the young leaves are perfectly green and healthy. The spots are not a characteristic symptom of bud-rot.

The bud-rot in Porto Rico resembles the descriptions of the bud-rot found in Jamaica, India and the Philippine Islands. It is not the Cuban bud-rot.

The disease apparently spreads most rapidly during the rainy season.

It is not purposed to go into a discussion of the cause of the bud-rot at this time. The disease is infectious and the causal organism may be carried from diseased to healthy palms by the wind, and by birds and insects. The butyrous odour given off by the decaying buds is especially attractive to insects, and in the more advanced stages the rotted portion literally swarms with larvæ. The infection appears to occur on the youngest leaf and grow down into the bud or near the base of a young tender leaf sheath, growing through the intervening sheaths until it reaches the growing point.

It is improbable that dissemination occurs from a palm in the earliest visible stage of bud-rot, because the causal organism is closely surrounded and enclosed by the leaf bases and sheaths. However, when the young leaf falls out the infectious material is exposed to the wind, birds, insects, etc. A diseased tree may remain a source of infection for several months, or until the soft tissues are completely rotted, dried up and carried or blown away.

Control measures must be directed toward the prompt removal and destruction of infected trees. The coconut cannot produce a new bud and a tree having the characteristic dead emerging leaf invariably dies. Such a tree should be felled at once. The bud must be destroyed, for it is almost as great a hazard on the ground as in the air. The method we have found most practicable is to fell all infected trees, cut off the tops about 1 to 2 feet below the leaves, drag the tops into a pile, saturate them with kerosene and burn them. The burning must be done carefully and conscientiously, as the young coconut tissues contain much moisture and are sometimes difficult to burn.

Every grove should be inspected frequently to prevent the spread of the disease from an occasional infection. It is not known to what distances infection may be carried by the wind. There seems no reasonable limit to the distance the disease may be carried by animals.

Jamaica has a law requiring the destruction of diseased buds by fire. THE WEST INDIA BULLETIN states, "Starting in 1918 a vigorous campaign was prosecuted under adequate supervision throughout the eastern districts It is reasonable to conclude that the low incidence of disease now (December, 1919) is due mainly to this systematic work."

In view of the above facts the control of the disease will be most efficient when the coconut grove owners act in concert and remove all the infected trees from a district. A group of diseased trees is the concern not only of its owner but of owners of all nearby groves. The disease can and should be prevented from spreading to all the coconut growing sections of the Island.

The Insular Department of Agriculture is anxious to give all possible assistance to grove owners in combating the bud-rot. This Station is also ready to co-oderate and will investigate any suspected cases of bud-rot.

SUMMARY.

Coconut bud-rot has appeared in Porto Rico and is spreading along the western coast.

It is easily recognized by the dead, yellow youngest leaf, which becomes broken over and finally falls ; by the fringe of horizontal leaves surrounding the apex of the trunk and the absence of the central column ; by the soft, rotted, malodorous bud.

The disease is transmitted by the dissemination of the causal organism from diseased to healthy trees, by the wind, birds, and insects.

Control measures are the destruction of infected trees as early as possible after the first symptoms appear, and frequent grove inspection to prevent reinfection.

Co-operation among grove owners is of utmost importance in making a single eradication campaign of lasting value.—AGRIC. NOTES published by Porto Rico Agric. Expt. Station.

CEYLON ENTOMOLOGY.

The following extract is taken from the Progress Report of the Government Entomologist for the Second Quarter, 1924:—

Shot-hole borer.—The Assistant Entomologist contributes the following notes on this subject:—

Inquiries addressed to Java regarding the possibility of utilizing the chalcid parasite which effectively controls *Xyleborus coffeæ* in that country against *Xyleborus fornicatus* in Ceylon indicate that the introduction of this parasite can be attended with no success owing to the entirely different gallery constructed by the former pest. No enemies of *X. fornicatus* in Java have been observed. This insect is still regarded as a very minor pest, of tea in Java and no explanation is forthcoming as to the reason why its depredations remain so limited.

X. fornicatus has recently been recorded as attacking cinchona in Bengal, the only previous record of the occurrence of this insect in India being in *Ricinus communis* at Bangalore.

Shot-hole borer has, during the period under review, been recorded for the first time in the Moneragalla district.

The plots of the New Peradeniya Estate experiments with individual manures are due for the first detailed examination and also for the second application of manures.

The final report of the experiments conducted on Sarnia Estate to ascertain the effect of general manures on Shot-hole borer is being prepared for publication.

Prevalence of Pests.—The following are some of the more important pests concerning which inquiries have been made during the period under review.

Tea.—Termites (*Calotermes* spp.) continue to be prevalent at various elevations. It may be mentioned that *Calotermes greeni* was found to be infesting a dead branch of a dying grevillea tree growing among tea on an

estate in the Matale district, but so far this species has not been found in the surrounding tea. It seems probable that in this particular instance the termite injury may be regarded as secondary. Experiments with various paint mixtures and wound dressings are being continued on some estates with the object of finding some substance which will protect exposed surfaces on tea bushes from the scavenging termites in the interval between prunings. At the present time the following programme is being recommended for the control of the scavengers. A careful and thorough pruning including the scraping out of all dead wood in exposed surfaces to be followed by the application of Bordeaux mixture spray, if branch canker has been prevalent, and by the careful application of coal tar to all wounds and exposed surfaces. This programme should be accompanied by the eradication of all mounds and underground nests of scavenging termites in and around tea fields. In this connection it may be mentioned that the experiments which are being made on an up-country estate with explosives to destroy the nests of these termites have given promising results and further trials are to be carried out. At present the simplest and most satisfactory method of eradicating these nests consists in digging them out and killing the queens and all other inmates possible.

Brown bug (*Saissetia hemispherica*) was reported from the Kandy and Nuwera Eliya districts in small numbers.

Tortrix (*Homona coffearia*) has been prevalent in the Dimbula and Bogawantalawa districts, and nettle grub (*Natada nararia*) has been reported from one estate in the Passara district. Both these caterpillar pests can be controlled in the early stages of an outbreak by the application of lead chromate either by spraying or by the sprinkling method.

The tea Pyralid or leaf-skeletonizer (*Piesmopoda rufimarginella*) has recently been reported from an estate in the Badulla district. It may be remembered that this caterpillar was originally discovered as a minor pest of tea in the Ramboda district in July, 1922, and was found on a few estates in the Badulla district in December, 1922. An account of this insect appeared in the YEAR-BOOK of the Department of Agriculture for 1923.

Tea mites, including "red spider," scarlet mite, and yellow mite have been prevalent on several estates at different elevations.

Coconuts.—The caterpillar (*Nephantis serinopa*) has appeared in the Negombo district, and the outbreak will be investigated by the Assistant in Entomology with the object of determining, if possible, to what extent parasites are present.

Vegetable Crops.—The investigations of some of the insect pests of vegetable crops are being continued by the Assistant in Entomology. In addition to the insects mentioned in the Progress Report for the first quarter, 1924, the following insects have been under observation:—

The caterpillars of *Dichocrocis magillalis*, *Arcilasia plagiata* and *Nygmia* sp. and the beetles *Epilachna 28-punctata* and *Mylloceras* sp. have attacked the leaves and the caterpillars of *Leucinodes orbonalis* have bored into the fruits of brinjal (*Solanum melongena.*) The beetle *Lema* sp. has attacked the leaves of snake-gourd (*Trichosanthes anguina*) and ash pumpkin (*Benincasa cerifera*). The leaves of tomato have been attacked by the caterpillars of *Prodenia litura* and *Plusia chalytes*, the latter being heavily

parasitized by small hymenoptera. The leaves of bandakka (*Hibiscus esculentus*) have been attacked by the caterpillars of the cotton leaf-folder (*Sylepta derogata*) which were heavily parasitized by small hymenoptera. The small flea beetle (*Nisotra badia*) was also prevalent on the leaves of the above plant. Chillies (*Capsicum* spp.) were infested by aphids but these insects were controlled by predators, including two species of coccinellids, two species of lace-wing flies (*Chrysopidæ*), and syrphid fly larvæ, and by small hymenopterous parasites.

Cotton.—Specimens of the caterpillars of *Euproctis geminata* were received from the Bibile experimental plots.

Miscellaneous.—The toona shoot-borer (*Hypsipyla robusta*) is under investigation and the co-operation of the Forest Department and of a few estates is being invited in order to obtain specimens

KILLING STUMPS.

In the MICHIGAN EXPERIMENT STATION QUARTERLY BULLETIN, VI (1923), pp. 60, 61, P. A. HERBERT has recorded the results of attempts to prevent stumps of trees sprouting. Stumps of Carolina poplar 3 to 6 in. in diameter, were wounded by gashes or borings and treated with various poisonous substances, including arsenic trioxid, phosphorus pentoxid, sulphuric acid, phenol, and hydrocyanic acid. None of the trees showed the slightest effect. In duplicated tests with sugar maple, white ash, basswood, beech, American elm, ironwood, jack pine, and Caroline poplar, some small jack pines, to which arsenic was applied in deep gashes at the base, were the only trees to be killed. Further experiments showed tentatively that complete girdling will kill stumps. Death, however, is hastened by applying arsenic solution consisting of 1 lb of arsenic and 1 lb of washing soda dissolved, after boiling together for one-half hour in a small quantity of water, in 4 gal. of water.—EXPERIMENT STATION RECORD, Vol. 50, No. 5.

TO DESTROY WEEDS ON PATHS.

A. A. RAMSAY,
Chemist.

To destroy grass or weeds on gravel paths or on chip tennis courts an arsenic mixture (1 lb. of white arsenic with ¼ lb. of caustic soda dissolved in 4 gallons of water) is frequently used, being both cheap and effective. A fairly concentrated solution of common salt applied hot is also effective, and so, too, is spraying with crude residual oil, such as is obtainable from gas companies. Both of these treatments would be rather more expensive, however, than that first mentioned.—AGRIC. GAZETTE OF N.S.W., Vol. XXXV. Pt. 6.

CEYLON AGRICULTURE.

MINUTES OF THE ESTATES PRODUCTS COMMITTEE OF THE BOARD OF AGRICULTURE.

Minutes of the twentieth meeting of the Estates Products Committee of the Board of Agriculture, held at the School of Tropical Agriculture, Peradeniya, at 2'30 p.m. on Thursday, July 10th, 1924.

Present :—The Acting Director of Agriculture (Chairman), the Government Entomologist. The Acting Government Agricultural Chemist, the Hon. Lieut.-Col. T. Y. Wright, Gate Mudaliyar A. E. Rajapakse, the Hon. Mr. James Peiris, Messrs. A. S. Long Price, H. D. Garrick, L. A. Wright, E. M. Windus, C. C. Durrant, N. D. S. Silva, Graham Pandittasekera, J. E. P. Rajapakse, Wace de Niese, T. A. de Mel, D. S. Senanayake, H. B. Daniell, G. W. Hunter-Blair, J. B. Coles, J. W. Oldfield, J. W. Scott, J. Horsfall, J. A. Coombe, N. G. Campbell, A. Coombe, E. Maberley Byrde, R. P. Gorton, and T. H. Holland (Secretary).

As visitors :—Messrs. N. K. Jardine, A. V. Philbrick, H. L. Elwell, Chas. Gibbon, and Huntley Wilkinson.

Letters and telegrams regretting inability to attend were received from the Hon. the Controller of Revenue, the Hon. Mr. H. L. De Mel, the Acting Government Veterinary Surgeon, Dr. W. P. Rodrigo, Messrs. D. S. Cameron, A. F. B. Smeaton, E. W. Keith, A. Dyson Rooke, J. S. Patterson and R. F. Battams.

Before commencing the business on the agenda, the CHAIRMAN referred to the death of the late MR. GRAEME SINCLAIR, who had taken a prominent part in the proceedings of the Committee for many years. A vote of condolence with MR. SINCLAIR'S relatives was passed, all standing.

The CHAIRMAN also referred to the death of the late MR. A. W. BEVEN who had also been a member of the Committee for many years. A vote of condolence with MR. BEVEN'S relatives was passed, all standing.

The minutes of the previous meeting, having been circulated to members, were confirmed.

The CHAIRMAN announced the appointment of the CHAIRMAN of the Low-Country Products Association as a member of the Committee.

The CHAIRMAN announced that the Coconut Research Scheme had been sanctioned by the Secretary of State for the Colonies, but that the question of the contribution to be made by Government was still under discussion.

Agenda Item 1.--Progress Report of the Experiment Station, Peradeniya.

The CHAIRMAN commented on the treatment given for Cacao canker by scraping and rubbing with copper sulphate crystals.

MESSRS. GARRICK and LONG PRICE said they had used the method with success. MR. J. B. COLES said that his experience was that the method was not successful in checking the disease.

The CHAIRMAN suggested that a saturated solution of copper sulphate would be easier to apply and equally effective ; and stated that comparative experiments would be made.

Agenda Item 2.—Proclamation and Schedule under the Plant Protection Ordinance.

The Proclamation and Schedule, amended after consultation with the Entomologist in accordance with decision taken at the last meeting of the Committee, had been circulated to members.

The CHAIRMAN stated that the Ordinance had been passed by the Legislative Council, but that certain alterations in the wording of the regulations were required by the Attorney-General's Department, and their publication was delayed on this account.

Agenda Item 3.—"B" Cacao manurial experiments, Experiment Station, Peradeniya.

The CHAIRMAN said that at the May meeting it had been decided that this experiment should be reorganized after consultation with MR. E. W. KEITH.

The proposed new scheme had been circulated to members.

MR. HOLLAND explained that the general mixture included in the scheme was one which had been used by MR. KEITH with successful results on Kondesalle Estate. The other mixture of artificial manures consisted of the same general mixture, with additional quantities of phosphoric acid and potash respectively. A mixture containing an excess of nitrogen had not been included, since it was known that manuring cacao with an excess of inorganic nitrogen did not produce beneficial results.

MR. BRUCE criticised the inclusion of Nitrate of Soda in the mixture, and stated that in the case of cacao, slow acting manures were to be preferred. After some further discussion it was decided to postpone a decision till such time as MR. KEITH should be present.

Agenda Item 4.—Report on Manning Coconut Trial Ground.

A report, furnished by GATE MUDALIYAR A. E. RAJAPAKSE, had been circulated to members. MR. LONG PRICE, after enquiring the age of the trees, remarked that the yield had remained approximately stationary.

LIEUT.-COL. T. Y. WRIGHT asked if the copra was dried separately.

MUDALIYAR RAJAPAKSE replied that the copra from each plot was separately dried.

MR. T. A. DE MEL asked if MUDALIYAR RAJAPAKSE had as yet drawn any definite conclusions from the experiment. MUDALIYAR RAJAPAKSE replied that he had formed the conclusion that, on old cinnamon land, a complete manure was required, and that the addition of organic matter and mulching with coconut husks were beneficial.

MR. BRUCE remarked that the poonac returned to the soil should be increased 10% to make up for the oil.

The CHAIRMAN thanked MUDALIYAR RAJAPAKSE for the interesting report.

Agenda Item 5.—Report on Alexandra Estate Coconut trials for 1923.

A report on these trials, furnished by MR. J. E. P. RAJAPAKSE, had been circulated to members.

MR. RAJAPAKSE said that the trials furnished a comparison between the results of intensive cultivation, manuring, and a combination of the two.

In commenting on the report he remarked that the Director of Agriculture, on his visit to the estate in January, 1924, had been satisfied that cultivation alone was not proving beneficial, and it had been decided to divide the unmanured plots into two, and give a double dose of manures to half the plots.

He remarked that the experiments were now in the transition stage between recording the results by the growth of the palms, and by the crops gathered.

From 1924, copra would be prepared.

LIEUT.-COL. WRIGHT said that it would be desirable that the costs per acre should be added.

MR. HOLLAND asked how the subsoiling was done.

MR. RAJAPAKSE replied that it was done with mamoties ; the work was practicable on a loose sandy soil but would probably not be possible on a stiffer soil.

In reply to an enquiry from the CHAIRMAN, Mr. RAJAPAKSE stated that the nuts were planted in holes, the tops of the nuts being eighteen inches below the surface of the soil.

The CHAIRMAN thanked MR. RAJAPAKSE for his report.

Agenda Item 6.—How often should deep ploughing and harrowing be done on coconut plantations.

The discussion of this item was postponed on account of the absence of MR. H. L. DE MEL, at whose instance it had been placed on the agenda.

Agenda Item 7.—Is broadcasting superior to ring manuring of coconuts.

MR. J. E. P. RAJAPAKSE said he had asked for this question to be placed on the agenda as he understood that several members of the Committee had adopted the broadcasting method, and he was anxious to know what results they had obtained.

LIEUT.-COL. T. Y. WRIGHT said that it was too early to give the results of his experience of the broadcasting method but that the palms in question were looking very well.

It was ascertained however that the method employed by LIEUT. COL. T. Y. WRIGHT was to dig a trench down the centre of the row, and was therefore not broadcasting proper.

MR. LONG PRICE thought that broadcasting was a satisfactory method if the land was clean, and the rainfall not too great.

MUDALIYAR RAJAPAKSE was in favour of ring manuring.

The CHAIRMAN said that, without cultivation, broadcasting was not advisable. Since the roots of the palms covered the whole ground, broadcasting was theoretically the best method ; but it remained to be seen which method was best in practice.

MR. BRUCE said that the question depended on conditions ; on uncultivated soil the best method was to start applying the manure near the tree, and gradually work outwards.

MR. RAJAPAKSE said that it was contended by the advocates of ring manuring that this method was better because more water fell near the tree. He had lately noticed that this did not appear to be so.

The CHAIRMAN said that part of the rain which fell on a coconut tree would be shed from the tips of the leaves, and part would run down to the base of the leaves and down the stem.

Agenda Item 8.—Tortrix in Tea.

MR. J. W. OLDFIELD introduced this subject on behalf of MR. A. T. SYDNEY SMITH who was unable to be present. He read a letter from MR. SYDNEY SMITH who said that he was bringing up the subject mainly as a result of correspondence with MR. ELWELL, of Gartmore Estate, Maskeliya, who was convinced of the necessity for concerted action against this pest. MR. SYDNEY SMITH thought that many estates which had practically never suffered before had been recently severely attacked. He did not think the advice offered by the Department of Agriculture was of a practical nature. He believed that the Department was adverse to collecting egg masses, and other old remedies, on theoretical and practical grounds. On the latter grounds failure might be ascribed to lack of organised effort and simultaneous action. He would be glad to know if the Department was in favour of a campaign of concerted action, and what the Department's ideas were with regard to such action. He would also be glad to know how far the new areas of infestation had been mapped out, and the spread followed. He thought that in view of the recent spread of the pest, the subject required far greater ventilation. The CHAIRMAN had given MR. ELWELL permission to address the meeting, and he would ask him to speak in continuation.

MR. ELWELL then read a memorandum on the subject. He emphasised the alarming spread of the pest, which he did not think was fully realised. The moth originally inhabited the jungle and only periodically descended to the tea; now the majority of the moths were bred in the tea fields. Formerly various methods were employed to combat the pest, but in default of a combined effort, the results were negligible and efforts had consequently been relaxed.

The only way to eradicate a pest was to attack the source of its supply, in this case the moth. The various methods of ensnaring the moth, however, had proved expensive and comparatively inefficient. Attention must therefore be turned to the egg masses.

MR. JARDINE had deprecated the collection of egg masses on the grounds that an egg parasite existed, and, by collection, the parasite would also be destroyed; instead he had advocated spraying, but this had proved impracticable in view of the larger areas now affected.

MR. ELWELL held that nature did not introduce parasites to kill out the host, but to keep it from over-producing itself; the parasite was therefore an asset to the Tortrix. Bird life was therefore desirable as birds both killed the parasite, and devoured large numbers of caterpillars. He contended that by the systematic collection of egg masses by all estates affected, the pest might be kept within bounds and thousands of pounds of tea saved annually.

MR. JARDINE then spoke in reply. He said the advice of the Department was published five years ago in Bulletins 40, 45 and 46; particularly in the latter two, for the former contained only the results of the first year's research. Bulletins 45 and 46 gave the only possible scheme for the control

of Tortrix in Ceylon. It had been extremely difficult to follow the spread of the pest since estates had not considered it necessary to inform the Department of its presence. The egg parasite to which MR. ELWELL had referred was reported in May and June 1917, before his arrival in the Island, to be attacking Tortrix eggs. It was with a view to ascertaining the prevalence of this egg parasite that he suggested that the eggs should not be destroyed, but placed in an egg tray as mentioned in Bulletin 40. The examination of over 15,000 egg masses however only revealed the egg parasite in two masses. It was found that in the collection of egg masses, many masses would be overlooked in dense bushes, and the larvæ which emerged from those that were left would have a better environment for their development and would produce a strong healthy strain of tortrix, less liable to the ravages of the polyhedral disease. Whether an attack would work itself out depended largely upon the strength of the bushes and the prevalence of the polyhedral disease. In a large area, where each estate is liable to attack by tortrix, it would be a waste of time and expense for one estate to adopt measures for the eradication of the pest, when its neighbours were doing nothing; so that where concerted measures were absent or not likely to be adopted the only means of ensuring any estate from infestation would be for that estate to separate itself from its neighbours by systematic flight breaks which would check the flight of the moth and reduce the area liable to attack. Each estate could then adopt those methods most suitable for itself and eradicate the tortrix within the boundaries of its flight breaks. This point is dealt with in Bulletin 45. Without a system of flight breaks, control became impossible and an area would be constantly liable to be re-attacked. The advice of the Department was the same as that given five years ago, namely to plant up flight breaks. The subsequent scheme of control might be summarised as follows :—

1. The flight breaks would arrest the pest in its flight.
2. They would check general distribution.
3. The area liable to attack would be reduced to a minimum.
4. The pest would be localised in the flight breaks.
5. The flight breaks would lend themselves to easy spraying, if found necessary.
6. Should the tea inside the flight breaks become attacked, such measures as collecting egg masses, destroying larvæ, trapping adults could be economically and efficaciously employed, or the few attacked bushes sprayed with anti-tortrix fluids.

A discussion followed on the merits and demerits of flight breaks and other methods of control.

MR. L. A. WRIGHT asked MR. JARDINE if he objected to the method of collecting egg masses.

MR. JARDINE replied that he did not, if it was done systematically.

MR. ELWELL argued that instances were known where the tortrix was known to have lifted itself beyond the flight breaks and been found feeding on the tea below them.

MR. JARDINE declared that it had been proved that the moth was not a wide flier; its limit of flight was about 150 yards, except when wind borne.

MR. ELWELL said that he was not particularly an advocate of the collection of egg masses, his contention was that some immediate concerted action was necessary.

The CHAIRMAN emphasised the fact that no information was received from estates as to the spread of the pest. Total eradication was not possible, but reduction by collection of egg masses might be effected. It would be necessary to ascertain whether the planters of the districts concerned were in favour of having the pest proclaimed under the Plant Protection Ordinance.

MR. ELWELL suggested that monthly returns of egg masses collected might be asked for from estates.

MR. J. B COLES enquired as to the height of the flight breaks.

MR. JARDINE replied that they need not be higher than 12 ft.

MR. ELWELL assumed that this would depend on the lie of the land.

MR. HORSFALL quoted an example of two well timbered estates that were free from the pest, the trees in this case being grevilleas 30 or 40 ft. high.

It was agreed that concerted action by collection of egg masses was desirable.

Agenda Item 9—Moisture in Sodium Nitrate Mixtures.

MR. BRUCE, Acting Government Agricultural Chemist, said that he often received samples of manures which were distinctly damp ; on examination he found that they contained nitrate of soda.

MR. BRUCE exhibited a sample of manure he had received, which was almost in a liquid state. His contention was that nitrate of soda owing to its hygroscopic qualities, was an unsuitable manure for inclusion in mixtures in Ceylon.

MR. OLDFIELD said he found it was the only manure which did any good in rubber.

MR. BRUCE replied that he was not speaking from the agricultural point of view, but that, as a matter of fact, his opinion from that point of view was the same. He advocated letting the soil make its own nitrates, which it would do if conditions were favourable.

Agenda Item 10—Revision of the Fertilizers Ordinance.

MR. BRUCE urged the necessity for revising the Fertilisers Ordinance, which was out of date and gave protection neither to the buyer nor to the seller. He believed the question had been referred to the Planters' Association in 1923, but no answer had been received. He quoted a case in which it was found that a manure passing as Blood Meal was made out of Chrome leather, mixed with a little animal refuse.

The CHAIRMAN remarked that there was at present no adulteration ordinance for food, drugs or manures.

MR. L. A. WRIGHT proposed and MR. E. M. WINDUS seconded that the revision of the Fertilizers Ordinance of 1901 is an urgent necessity.

This was carried.

T. H. HOLLAND,
Secretary, Estates Products Committee.

PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA.

For the Months of May and June, 1924.

TEA.

Supplying of vacancies in the old tea plots was started in favourable weather on June 5th. 1900 small plants, grown from seed from Norwood and Kanapediwatte estates, were raised with a transplanting tool and planted out. 956 eighteen months old stumps grown from Kotiyagala seed were also planted. Unfortunately only half an inch of rain fell between June 10th and June 24th. The young plants which were moved with the transplanting tool, however, do not appear to have suffered at all from the drought. It is too early to judge of the fate of the stumps. The majority of the stumps were shaded and mulched before fresh rain fell.

The young dadaps in plot 144 which were planted in June 1921, with the idea of replacing the old trees, were cut down to 4 ft. 6 inches. The old trees will be cut out next year.

RUBBER.

Fifty plants of a large seeded variety were received from Heneratgoda gardens in the last week in June. Some of the plants were very overgrown, and the majority arrived in bad condition. They were planted along the side of the road bounding the Economic collection on the South-East side.

CACAO.

An examination was made in June of a number of trees which, in February and March, had been treated for stem canker by light scraping of the cankered bark and rubbing on crystals of copper sulphate. In no single case had the disease spread from a patch thus treated, while in cases where the disease had not reached the wood, healthy bark was found under the formerly diseased and now dead bark. These observations confirm a similar examination made last January. The cost of this method of treatment was Re. 1-82 per acre with a check roll average of 56 cents.

It is very much cheaper than clean excision of all diseased tissue. It is proposed to try painting with an antiseptic solution after scraping, in place of rubbing with copper sulphate crystals, as this forms the most laborious part of the operation. Flowering has been profuse, and prospects for the next crop are good.

COFFEE.

The re-organisation of the planting of the 6-acre coffee field consequent on the partial failure of JACKSON'S Hybrid and KENT'S Arabica coffees in the upper and more exposed part of this field was postponed for want of rain. New holes have been dug.

COCONUTS.

The nuts from specially selected trees received from Jugra Land and Carey Ltd. F. M. S., in February, have germinated well in nursery beds. Only three out of 29 nuts have failed to germinate. An application of ½ lb. Ammo-phosphates (20/20 grade) was made to every alternate tree of the Dwarf coconuts between the iver and the main entrance road.

FIBRES.

A report was received from MESSRS. J. THOMAS & Co., Calcutta, on a sample of "Roselle" fibre sent for valuation. This firm reported "The nominal value of 'Mestha' fibre (comparable to the supplies of 'Roselle' submitted) at the present time is Rs. 10-8-0 per Calcutta bazaar maund of 82 2/7 lbs." This is equal to Rs. 285-80 per ton, and represents, according to yields obtained on the Experiment Station a gross return of between Rs. 206-30 and Rs. 251-30 per acre. Various methods of extracting the fibre were tried during the last trials and it is not possible to give a reliable estimate of the cost of production. Further plots of this fibre have been sown and accurate costs will be recorded on this occasion.

FODDER GRASSES.

The condition of the RHODES grass (*Chloris gayana*) is very poor, and it has been decided to discontinue the growing of this grass after August 1st, when the third year of the trials will be completed.

NAPIER'S grass (*Pennisetum typhoideum*) is doing very well and giving heavy yields of fodder. This plot will be included in the trials from August 1st. Cuttings of this grass have been supplied to several planters and agriculturists in different parts of the Island.

A number of plots in the Panchikawatte paddy fields, which have proved unsuitable for paddy, were planted up partly with Water-grass (*Panicum muticum*) and partly with Efwatakala grass (*Melinis minutiflora*). The plots are swampy, and in places springs containing a good deal of iron are present. The Water-grass made good growth, except where springs were actually present, but the Efwatakala grass failed almost completely. This latter grass is very similar in appearance and habit to Water-grass but appears to require drier conditions. All the plots referred to are now being planted up with Water-grass.

An examination of the figures of the fodder consumed by the imported Scinde cows, lately temporarily housed on the Experiment Station, reveals that if the maximum yield of Guinea grass of nearly 40 tons per acre per annum could be maintained, one acre of this grass would be sufficient to maintain three large cows or say four small local animals; though there would probably be some difficulty during the dry months. With a yield of 25 or 26 tons two large cows or three small animals could be maintained.

COUCH GRASS AND ILLUK.

Extra funds have now been allotted for forking out these weeds and all the additional village labour obtainable has been utilised for the purpose. The following areas have so far been dealt with :—the fodder grass plots (5 acres), plots 16, 17, 18,19 and 20 (5 acres), the Economic collection (12 acres). Many tons of these grasses have already been burnt or carted away.

GREEN MANURES AND COVER PLANTS.

Vigna oligosperma :—A few flowers and one or two pods have now appeared. Cuttings were again planted out : on this occasion thick bunches of the plant were put in, and practically every bunch is growing well. When single cuttings were employed (even when a few roots were attached) complete failure resulted. Some cuttings have been planted under old rubber, and these are growing.

Indigofera endecaphylla :—Some more seeds were sown in a well prepared bed in the fruit plots and have germinated very well. The growth of the seedlings is however very slow. Similar beds of cuttings have also been planted up and most have struck well. The growth resulting from the seed sown in the New Avenue rubber however is patchy and poor and the plant does not seem easy to establish in unfavourable conditions.

Clitoria cajanifolia :—Young plants continue to make satisfactory growth on a steep washed slope. Attempts are also being made to propagate this plant from cuttings; prospects do not appear favourable, but it is too early to make a definite statement.

Desmodium triflorum :—A plot of this plant has been planted under old rubber.

GENERAL.

Drains have been cleaned throughout the whole station ; and where necessary deepened and improved. In the New Avenue rubber, "B" cacao and other areas steps of stakes of jungle wood have been constructed in the main drains to check further erosion and loss of silt.

The whole of the labour force received Anchylostomiasis treatment during April.

The rainfall was 5·29 inches and 7·98 inches in June.

T. H. HOLLAND.
Manager, Experiment Station, Peradeniya

MATALE DISTRICT AGRICULTURAL COMMITTEE.

Minutes of a meeting of the Matale District Agricultural Committee held on the 10th June, 1924, at 2 p.m, at the Matale Kachcheri with the Assistant Government Agent in the Chair. There were also present :— Messrs. H. D. Garrick, R. A. Senior White, N. K. Jardine, Plant Pests Inspector, Ratemahatmaya, Matale South, Ratemahatmaya, Matale East nd Mr. G. F. Abayakoon, Hony. Secretary.

1. Minutes of the previous meeting were read and confirmed.

2. The Secretary of the Committee, MR. G. F. ABAYAKOON, read an interesting paper entitled "Some Random Notes to increase the Food Supply in the District." An informal discussion followed, but it was finally decided at the suggestion of MR. JARDINE that the paper should be fully discussed at the next meeting when the Committee would be able to benefit from MR. AUCHINLECK'S views.

3. *Transport of Jack Trees.*—MR. GARRICK said there was another matter he wanted gone into but he was not quite sure if he was in order. A good deal of correspondence had appeared lately in the local press as regards jak growing as a source of food supply. It had come to his notice recently that jak trees were being cut by the Forest Department and railed for Government purposes. He urged that enquiries might be made as for what purpose Government required jak logs and whether jak would not be more useful as a food supply. The Chairman undertook to make enquiries.

GENERAL.

EXPERIMENT STATIONS IN AMERICA.

It is sometimes suggested that the work of the experiment stations has reached the stage of diminishing returns. This is not said in a critical or doubting way but rather by comparison with the earlier years, when the opportunity for quick returns was open in many lines. It is a recognition of the fact that, in general, a more difficult stage has been reached in agricultural investigation which requires more time to accomplish desired ends, and hence may lead to a decrease in volume of quickly applicable results of striking importance.

In a sense the suggestion is a rational one and not without foundation. The extent to which it is true depends upon the measure employed in evaluating the product. The output of the stations in the first 25 years of their existence was so large and varied as to make a tremendous impress. It first won the confidence of the public, and this made possible far-reaching reforms in nearly every branch of the industry. In this way many of the questions requiring less intensive study and for which existing facts of science could be drawn upon have been given attention. But while this has been going on an increasing amount of fundamental research has been put under way and the technique and devices for it worked out; and beyond this, workers have been trained in quite large numbers who have the outlook and the understanding of original inquiry. This may serve to offset the tendency which would otherwise make itself felt.

In how far the product of experiment and investigation may diminish in relation to workers, funds, and facilities will depend to considerable extent on the attitude of those engaged in this field, and the use they make of their opportunities. In the possibilities for profitable work there is manifestly no decline, and the larger dependence which now rests upon research makes the field an increasingly stimulating one. There will be need for experimentation for many years to come—always, as far as can now be seen. The field appears larger than ever before. But the character of the problems and the kind of information needed have notably changed. Certain types of work and certain kinds of information have become inadequate. Results of limited applicability and information which supplies rules but not reason only partially satisfy the demand in the present stage of enlightenment. Facts which can not be intelligently interpreted in relation to local conditions do not meet the need of the extension forces.

A conspicuous product of agricultural investigation has been an increasing appreciation of the type of work which gives understanding as well as bare facts, an expression of the desire for greater intelligence and more intimate knowledge. The value of such effort has been borne in on the public and its advisers as research has advanced. It recognizes the force of BACON'S contention that "experiments of light are even more to be sought after than experiments of fruits," and accords with VERGIL'S view that

"fortunate indeed is he who perceives the causes of things." Our own ARMSBY spoke a great truth when he said that "one principle well founded is worth a thousand facts, because it includes them all." Not every worker can be so fortunate as to develop a new principle, but he may be able to uncover facts which lead to a new point of view or help to clarify what has been wholly empirical.

There is admittedly quite wide variation in the returns from money and effort invested in research. This has always been so, and it is probably no wider now than in the earlier stages. It lies in the nature of research, the outcome and the time limit of which can not be predicted. But omitting what was in reality extension work, it will hardly be questioned that the experiment stations are giving a greater actual return to farming and the public than at any earlier period. They are enabled to do this because their work has steadily advanced, embodied the new insight which has been gained, changed its point of view, and improved its technique. The results are more definite and accurate, more safe of interpretation, and the really new information is often supplied by a more direct and even more rapid process.

If the law of diminishing returns has already begun to operate with respect to certain types of experiments, it is because of inherent difficulties with the methods. In certain lines investigation by conventional methods appears to have proceeded about as far as it can be expected to yield results commensurate with the outgo of time, money, and human energy. The limitations of such common procedure have become quite obvious, and have made it clear that without new avenues of attack some of the large fundamental problems of agriculture will not be solved. The profitable stage of the gross attack, with the extensive collection of complex data in the hope that ultimately it would enable deductions or lead to generalizations has largely passed, except as a preliminary step. The tendency is toward simplification of the problem and of the conditions of experiment, the breaking up of complex problems into their integral parts, the narrowing of the objective and the intensification of the method. It is marked also by the study of relationships, so that the effect of conditions may be better understood. Where this course is not followed results are less important than at an earlier stage, and the procedure fails to adequately represent advance in method and interpretation.

There is no science without progress. Isolated facts, however numerous, do not constitute science. "Science does not consist in the accumulation and cataloguing of such information, but in the establishment of relations between observed facts." Facts of observation were recorded long before they were understood. The determination of their meaning is a later step. Since science and discovery move forward by an evolutionary process, the means of adducing facts must likewise be a process of development. This comes as a result of progress in science and change in the point of view respecting the matter under investigation. Hence study of the method in order to improve the plan of attack is hardly less essential than study of the results secured by it. Without such study of both method and results, the making of experiments is relatively simple and may be a matter of routine.

A good observer is not necessarily a skilful investigator. His work may be that of a collector instead of a student of reactions and relationships

and factors influencing them. Or his deductions may stop with comparisons, may not express the attitude of mind which travels from facts to conclusions. And so inadequacy in the plan of attack may escape him, or at least not result in correction which makes it more efficient and more original. Naturally such change ought not to be so abrupt as to sacrifice or endanger work long under way, but it ought not to be too long delayed. The real situation ought to be faced alike by investigators and those in authority. Otherwise the mistake will be made of clinging to means which in themselves have proved inadequate to carry through to final results.

There seems sometimes to be an exalted idea of the value of continuity—the continued pursuit of a subject by a fixed set of experiments studiously adhered to from year to year. Important as continuity is in following through an investigation, it may be as subject to criticism as fragmentary and vacillating effort unless the means and ends of research are being advanced. If it becomes stereotyped it is likely to degenerate into a round of routine, and it will not reflect progress in visualizing and pursuing the problem. There ought of course to be real intelligence behind every series of experiments, not alone at the outset but throughout succeeding stages. A protracted series especially ought to be inspired by purpose and reason, and, guided by critical judgment as to where and when it is necessary to supplement the usual line of observations. Neglect to digest the data and give them to the public in other than comparative form may be construed as mute evidence of the ineffective character of the work.

The conventional type of experiments still constitutes a considerable part of the station programme. It is among these that the question of commensurate return in future finds most foundation. The weakness of some of them if subjected to discriminating analysis would be disclosed, and their justification might be questioned. The attempt to set forth succinctly the real problem they were aimed at and weigh the competence of the procedure to give final results capable of interpretation would show their complicated nature and the reason for their failure to advance.

One extensive series of experiments in operation more than 20 years was found to embrace some 20 separate questions, not intimately related to each other or to a general problem ; and yet reliance throughout was placed on routine determinations by conventional methods and without attempt to exercise definite control over the larger factors of variation. It may have been of such a series that a recent writer remarked upon the "many figures" obtained and commented that "it is difficult to understand how accurate results could be expected when, to an already little understood complex substance, such as soil, is added a series of substances whose effects are practically unknown."

Research implies not only a problem but a type of mind with an impulse to wonder, to inquire, and to understand. It also implies time to think and

study, as well as to carry out experiments and record data. Learning to think is one of the most important fundamentals in the making of an investigator. The exercise of the faculty of thinking is indispensable to good investigation of any type, although sometimes too little provision is made for it. DR. F.M.MCMURRY, speaking at the recent Chicago Convention, remarked that eating and digesting are two different processes ; thinking is the sum of the activities that provide for the digestion of facts. Accordingly he emphasized as essential to success "the ability to think, openness of mind so that one is receptive of new influences, and energy to think and execute." These are as essential in experimenting as in teaching, the subject under discussion ; and so also is his further declaration that "to meet the demands of life, no matter in what field one is at work, success is not something resulting solely from past knowledge and activity ; it is due to new effort, to a new adjustment. We can not live on our past alone." Thinking in experimenting must therefore be current, and it must guide future steps.

Closely related to the element of returns is the effect of too many projects, itself quite a common cause of decreased output. This may sound paradoxical, but the attempt of an individual or a station to carry more lines of experiment and investigation than can be properly cared for may easily defeat the real purposes, for reasons mentioned above. It may lead to widely scattered effort, too superficial attempts to get at the facts, too limited thinking about the method and results and, added to this, too meagre support for any of the undertakings. It may and often does hold back results, because there is not time to compile and digest them and make them ready for publication. Sometimes it is responsible for unwarranted repetition because the investigator falls behind in his subject or continues a course of experiments after it has ceased to be productive.

What a station may do is rather definitely limited by its staff and its funds. In their zeal, workers may be over-ambitious; they may overestimate their capacity for doing many things well, and underestimate the amount properly involved in the various projects to make the work adequate and complete. If the funds are not sufficient to go around, something must be omitted, and too frequently that something is an important essential.

Obviously financial support will play a large part in determining the volume of returns. This is due to the fact that more elaborate and expensive facilities are needed than formerly sufficed, and to the fact that a dollar does not go as far as it did a decade ago. An increase in research funds will help a station to spread its work over a wider field and in this way to perform a larger service, but it will not strengthen its research effort unless it strengthens the research staff.—*Extract from Editorial*, EXPERIMENT STATION RECORD, Vol. L, No. 5.

BETEL VINE CULTIVATION.

K. J. ALEX. SYLVA.

Assistant Curator, Botanic Gardens, Henaratgoda.

The betel vine, *Piper Betle*, Bulath-wel, Sinh., belonging to the Natural Order Piperaceæ, is a climbing plant indigenous to and cultivated in almost all the tropical Asiatic countries for its spicy leaf, which is greatly esteemed by the natives. They chew it either alone or after treatment with lime wrapped round slices of arecanut in the belief that it contains certain antiseptic and sustaining properties, which can disinfect the mouth and preserve the teeth from decay. The cultivation of the betel vine has been known in Ceylon from early times.

VARIETIES.

Several species of this vine are cultivated in Ceylon and used for different purposes. Of these, the "Gal-bulath"—the large-leaved variety, and the "Geta-thodu," the small-leaved variety, also known by the name "korakka," are cultivated solely for the sake of their leaves, which command a ready sale in the market. The other allied species are the "Wel-mal" grown for the sake of its flower as a spice which is chewed alone or with betel proper; the "Naga-walli" or the "Siribo," the variegated species as a curiosity or for offerings to temples and seldom used for chewing; and "Mala-bulath" which is more or less used in medicine and occasionally used for chewing.

With these introductory remarks the writer will deal in this article only on the cultivation of bulath proper, *Piper Betle*, which is so extensively cultivated purely for the sake of its leaves.

SOIL AND CLIMATE.

It is interesting to note the adaptability of the plant to different climatic conditions and soils at different elevations. It grows in a variety of soils from almost at sea level up to about 4,000 feet elevation. At high elevations the vine is planted and trained against perennial trees such as Jak (*Artocarpus integrifolia*), Arecanut (*Areca catechu*), Tulip (*Thespesia populnea*), &c. A vine planted in such situations seldom or never receives any attention except that at the time of planting.

The Betel vine requires a warm humid climate and a soil rich in humus. Deep gravelly and clayey soils are unsuitable and should be avoided. An open situation with an east to west aspect is considered to be the best site for a betel enclosure.

PREPARATION OF LAND.

A well-defined drainage system by means of a contour drain 2 ft. deep is absolutely necessary, as the plant is susceptible to the ill-effects of a water-logged soil or encroaching roots of neighbouring trees.

The land should be thoroughly cleared of all rank vegetation, made free from stones and roots, and forked or dug to a depth of at least 1 foot, and the soil broken up until it is brought to a fine state of tilth. Beds are usually made 3 feet wide with a narrow path, 18 inches wide, between, so as to facilitate weeding, watering, &c.

In low elevations where there is a scanty rainfall, the beds are invariably prepared an inch or two below the surface level; this depression is eventually filled up by after-cultivation. A good layer of the leaves of Keppetiya (*Croton lacciferum*), Kenda (*Macaranga tomentosa*), Kahata (*Careya arborea*), or Mudu Kaduru (*Ochrosia borbonica*), is buried in the beds and allowed to remain for a period of 4 to 6 weeks to undergo decomposition. The addition of leaves of the Mudu Kaduru (*Ochrosia borbonica*) to beds is considered as one of the best precautions against fungus diseases attacking the betel vine. Just before planting, the beds are strewn with dead leaves or some such material and burnt. It is also useful to rake in a liberal amount of burnt refuse from the garden fire, then rake off all rubbish and leave the surface level. After this process a good quantity of humus in the shape of decayed leaves is added to the soil and mixed up and the soil brought into a friable condition. No cattle or artificial manure of any kind is used while preparing the beds; it is applied as a top-dressing when the vines are in a vigorous and healthy state of growth.

CULTIVATION.

The betel vine is always propagated from cuttings. These should always be selected from vines free from disease and obtained from the off-shoots of the main vine and not from the main stem.

They should be at least 1 foot long with about four or five nodes or joints. Off-shoot cuttings are sold at Rs. 10 to Rs. 15 per 1000. There is no fixed time for planting the cuttings. However, the best results can be obtained when cuttings are inserted in the beds just before a short period of rain. On the other hand, a drought immediately after planting will result in a prolonged period for the plants to get themselves established. The best months for low elevations would be March-April, and, for medium elevations, November-December.

The cuttings should be planted one foot apart each way in the bed, burying at least 2 nodes or joints in the soil. Low shading by means of cadjans or some such material is very helpful till they take root, which usually takes a period of 4 to 6 weeks. During this period, if there is no rain, watering should be done late in the afternoon. When the plants show signs of new growth, all shading should be removed and good stout sticks of about 7 feet long are driven into the soil close to each individual vine which is eventually trained on to it. At this time a sprinkling of well decomposed cattle manure, alone or mixed with bone dust (about ½ lb. of bone dust to a basket of cattle manure), is given as a top-dressing and the soil slightly turned over to form a mulch. The addition of manure at this time stimulates the plant and encourages the growth. It is invariably the practice in the low-country to mulch beds with keppetiya, kenda, kahata and mudu-kaduru leaves. This procedure not only helps the retention of moisture but adds humus to the soil and gives very good results. This practice of manuring and mulching has to be continued

periodically to prevent the exhaustion of the soil which would eventually diminish the leaf crop. A properly managed betel enclosure will last 4 to 6 years.

HARVESTING.

As a rule the betel vine takes about 4 to 5 months to come into maturity and to be fit for picking leaves. The leaves borne on the off-shoots are more succulent and more pungent in taste than those produced on the main stem. The former are very popular and a ready sale is always ensured at a higher price. A betel plot with 1000 vines will produce four to six thousand leaves every fortnight which can be sold on the spot at varying rates. During January, February and March they fetch fancy prices as much as Rs. 4 to Rs. 6 per 1000. The usual price at ordinary times varies from 50 cts. to Re. 1 per 1000 leaves of the main stem, and from Rs. 1·50 to Rs. 3 per 1000 leaves of the off-shoots.

AN IMPROVED METHOD OF LUCERNE CULTIVATION, II.*

ALBERT HOWARD, C.I.E., M.A.,

Imperial Economic Botanist.

At the previous meeting of the Indian Science Congress Lucknow, 1923, an improved method of lucerne cultivation, suitable for alluvial soils, was described.† This consists in growing the crop on flat beds, two feet wide, with irrigation channels, one foot wide, between the beds. These channels act as drains during the monsoon and help to maintain the aeration of the soil of the beds. The seed is sown on the beds and in the irrigation channels, so that the stand appears to be continuous and no bare ground is visible. In the rains, the plants in the trenches die out. By this system, high yields are obtained, the texture of the soil is preserved, the amount of irrigation water needed is substantially reduced while weeds give little trouble. A plot, sown on October 20, 1921, gave eight cuts up to July 11, 1922, at the rate of 70,000 lb. of green fodder to the acre.

In October 1922, an experiment was begun at Pusa in order to compare the growth of lucerne on the ridge and on the flat bed system. The plots were one quarter of an acre in area and were in duplicate. The lucerne was sown on October 22, 1922, after green manuring with *sanai* (*Crotalaria juncea L.*), and oil cake, at the rate of ten maunds to the acre, was applied some time before sowing. Higher yields would probably have been obtained if the soil had been richer. The crop on the ridges and on the beds was very uniform, that in the trenches, which was sown too late, was

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*A paper read before the Agricultural Section, *Indian Science Congress, 1924.*

†*Bulletin 150, Agri. Res. Inst., Pusa, 1923.*

poor. This materially reduced the total yield. The hot weather of 1923 was not at all severe while the rainfall was only 28·37 inches compared with the Pusa average of 47·5 inches. These circumstances greatly favoured the crop of the ridges which, in normal years, dies out during the hot months of April and May. The number of cuts was eleven and the yields are given in Table I.

TABLE I.

The yield of lucerne on flat beds and ridges at Pusa.

Plot	First cut Dec. 17 1922	Second cut Jan. 25 1923	Third cut Feb. 28 1923	Fouth cut Mar. 28 1923	Fifth cut May 5 1923	Sixth cut May 24 1923	Seventh cut June 16 1923	Eighth cut July 12 1923	Ninth cut Aug. 7 1923	Tenth cut Sept. 7 1923	Eleventh cut Oct. 20 1923	Total
	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
1 (ridges) -	10 8·5	18 23	21 9	18 13	18 23	15 39	11 23	10 5	10 4	7 0	5 29	147 16·5
2 (beds) -	17 27·5	25 23	24 31	19 33	21 22	14 33	10 10	10 28	13 35	9 34	3 35	172 31·5
3 (ridges) -	12 35	19 35	21 14	19 26	20 1	15 26	13 9	12 28	14 38	9 36	7 26	167 34·0
4 (beds) -	20 28	26 19	25 17	19 3	17 15	14 10	13 19	13 32	17 31	11 22·5	6 22	186 18·5
Total of each cut -	61 19	90 20	92 31	76 35	77 21	60 28	48 21	47 13	56 28	38 12·5	23 32	674 20·5

It will be seen from the figures that good cuts were obtained from December till August after which a rapid falling off in growth took place. The second half of the rains is the period when the Pusa soil loses its permeability. The pore spaces become waterlogged and soil aeration is difficult. Although the season favoured the ridges and the irrigation trenches did not bear a full crop, the total yield of the beds exceeded that of the ridges by 44 maunds, over ten per cent.

The great advantage of the beds over the ridges lies in the saving of water. In the experiment, the irrigation water used was not measured directly but was determined by noting the time taken—the pumping engine being worked as uniformly as possible during each watering. Between October 23, 1922, and June 11, 1923, the plots were irrigated twenty-one times.

The total time taken in watering both sets of beds was 40 hours 27 minutes while the corresponding ridges occupied 51 hours 49 minutes. Assuming that the flow was constant, the saving of water in the bed system was 25 per cent.

A further advantage of the bed system is that lucerne can be made to behave as a perennial in Bihar, when the fodder obtained in the second and third years is much more luscious than that of the first season. To accomplish this, the old crop must be manured and well cultivated in October as soon as the rains are over. This is done by top dressing with Chinese compost, at the rate of 20 carts to the acre, and breaking up the soil thoroughly with vine hoes after which the beds and channels are remade. A plot treated in this way is now in its third season and is still doing well. Another benefit obtained by renovating the old crop is that green fodder is available in November and December at a time when the supplies of this material are often short. Cultivation by itself is not sufficient to renovate old lucerne in Bihar. Organic matter is needed as well. A recent trial carried out at Pusa showed that the result of top dressing old lucerne with Chinese compost once after the rains was to increase the yield of the next twelve months by 70 per cent.

In previous publications, the advantages of a supply of good lucerne hay in India have been emphasized. This material, as is well known, is an excellent fodder for all kinds of live-stock and when pressed into bales is very valuable both for military purposes and as a famine reserve. I should like to reply to two criticisms which have been made to this suggestion. The first is that lucerne will not keep during the rains in India. Lucerne bales, compressed to the Army standard of 90 cubic feet to the ton, have been stored for six years on an open verandah at Pusa and the fodder is still palatable. Loose hay suffers no damage during the rains when stored in an ordinary *bhusa* shed. The second criticism is that lucerne hay cannot be made in India without loss of leaf, the most valuable portion of the fodder. Excellent hay is made in the ordinary routine at Pusa at all times of the year except during the monsoon and no loss of leaf takes place even in the driest weather. Such damage is easily avoided if the fodder is always handled when it is slightly damp with the morning dew. It is possible that the difficulties encountered in making lucerne hay may be due to want of skill on the part of the labour employed. If so, this can easily be remedied by importing, for training purposes, a few intelligent cultivators from the tobacco tracts of North Bihar. Here the people are accustomed in tobacco curing to handle, without breakage, a very brittle product. It is much easier to make good lucerne hay than it is to cure tobacco.

Two things are necessary before lucerne can be introduced into the rural economy of the country—good demonstration work and a reliable supply of seed of a suitable variety. To initiate the demonstration work, it is suggested that every Government farm should maintain a well-managed plot of lucerne for the use of its work cattle. The seed supply is a more difficult matter as in many places lucerne does not seed well. Preliminary experiments, carried out by MR. ILBONTO BANERJI, M.Sc., a Research Student in the Botanical Section of the Pusa Institute, indicate that the fertilization of the lucerne flower is limited by temperature. Well-developed pollen grains are formed even in the hottest weather but they do not germinate unless they are artificially cooled. Seed growing is therefore likely to be most successful in the colder parts of North-West India and on the more elevated regions of the Peninsula. Some of the hill tracts, including the Kashmir Valley, may also contribute to the seed supply.—AGRICULTURAL JOURNAL OF INDIA, Vol. XIX. Pt. 3.

KORAI GRASS CULTIVATION IN KARUR TALUK.

N. SUBRAHMANIAM.

Farm Superintendent, Adulurai.

Korai grass is a kind of grass used for weaving mats. The cultivation of this grass has of late years increased in importance in this taluk and people take to it as a paying concern. The grass is cultivated in padugai lands of both the Amaravati and Cauvery Rivers in Karur taluk. These padugai lands are taken for cultivation under lease by a few mirasdars, who, in their turn, sublet them in small extents to others for cultivation. This grass is cultivated by a special class of people called Oddakkars. Some Mohammedens and Kaikolas also cultivate this to some extent. In addition to local supply, the grass is mostly exported to parts of Tinnevelly, Dindigul, Trichy and Salem. It is now becoming a profitable crop for cultivation. There is now a keen demand for the grass and the price of the same has risen considerably during the past few years.

Soil.—Padugai lands receiving heavy deposition of silt during floods and having good irrigation and drainage facilities are the best suited for its cultivation.

Season.—The planting season is March.

Preparation.—The land is dug thoroughly with mamoties to a depth of 1 foot 6 inches in January when the soil is in a good friable condition. The soil is then turned over twice and the grass and other weeds are completely picked and removed. In February small beds 8 ft. x 9 ft. similar to ragi beds, are formed with irrigation and drainage channels at suitable distances.

Selection of Seed Nuts and Planting.—Nuts are dug in February from old plantations, the clods of earth broken and removed and the nuts are then cleaned free of grass and other weeds. These are then put into pits and water is sprinkled over them. These pits are covered over with grass for hastening the germination of the nuts. The nuts are removed from the pits at the time of planting when they would have just put forth small sprouts.

Planting.—In March shallow furrows of 2 inches depth are made with mamoties at distances of 4 inches to 5 inches and the nuts are placed close together longitudinally along the furrow. This is covered over with the earth removed from the next furrow and the beds are watered. Sprouts come out in 2 or 3 days.

Irrigation and After Cultivation.—The beds are watered from channels once in 10 or 15 days. Much attention is to be paid to keep the fields clean of weeds which are to be dug, picked and removed twice in a year. This is done after each harvest is completed.

Harvest and Preparation.—The harvest is done only in bright weather which is very essential for the drying of the grass; else the grass will be completely spoiled and decoloured. Hence the interval between two harvests and the number of harvests in a year depend upon seasonal circumstances and the growth of the grass which is controlled by the nature of the soil. The grass comes to harvest in about four months after planting, *viz.*, in July when it would have grown to a height of 8 ft. to 9 ft. The next harvest is

done in December. The best practice is to take two harvests in a year, *viz.*, one in July and the other in December. But from the third year after planting some take 5 crops in two years.

The grass is cut close to the ground with curved sickles which are specially shaped for the purpose. Then the cut grass is placed with the butt ends together and bundled up. The top portion of each bundle bearing the inflorescence is cut off evenly according to the growth of the grass. These bundles are sorted into different grades according to the length of the bundle. They are removed to the river-bed, opened out and dried for a few hours. This is done to make the grass elastic. The grass is split longitudinally and spread in the sand for two or three days for further complete drying. It is then bundled into required sizes, usually with a girth of 48 inches. The grass is then ready for market. All these operations from cutting to final bundling are done on contract system at one rupee per bundle of dried grass of 48 inches girth. The yield depends upon the soil where it is grown, upon the amount of alluvium deposit received by the land every year, and also upon the care and attention paid in cultivation. For the first year each cutting gives forty bundles per acre and for the remaining period each cutting gives fifty bundles of dried grass of 48 inches girth. It is not advisable to keep the crop for more than seven years in one field.

CULTIVATION EXPENSES PER ACRE.

Initial Expenses.—

Digging the land once and turning the soil twice	Rs.	120 00
Picking and removing weeds	,,	25 00
Forming beds and channels	,,	6 00
Digging nuts from old plantations, breaking and cleaning	,,	10 00
Forming small channels and planting nuts	,,	22 80
Removing weeds, etc., and hoeing twice	,,	20 00
Total	Rs.	203 80

Recurring Expenses.—

Weeding and hoeing charges for 6 years — 12 times	Rs.	120 00
Cutting, splitting, drying and bundling.—		
1st year — 80 bundles		
Next six years — 600 ,,		
Total. — 680		
Contract rate for 680 bundles of 48 inches girth at Re. 1/– per bundle	Rs.	680 00
Lease amount at Rs. 100/– per acre for 7 years	,,	700 00
Grand Total	Rs.	1,703 80

Value of Produce.—

Value of 680 bundles at the average price of Rs. 6/– per bundle	Rs.	4,080 00
Total expenditure for seven years	,,	1,703 80
Net profit per acre for seven years	,,	2,376 20

—MYSORE ECONOMIC JOURNAL, Vol. X., No. 6.

[Korai is *Cyperus rotundus*, the Sinhalese Kalanduru, but in this case probably some other species of *Cyperus* is intended.—Ed.]

PALM OIL EXTRACTION-EXPERIMENTAL WORK IN NIGERIA.

Palm oil is prepared by native processes, which in spite of local variations fall into three quite distinct classes. Oil prepared by the "soft oil process" is of high quality, its content of Free Fatty Acid varying generally from 15—18%. It is within the power of the operator to make oil of a higher class by this process, but the better the quality desired, the greater is the amount of labour entailed. The "hard oil process" is distinctly less laborious and yields at least 25% more oil than could be obtained by the soft oil process, from a similar quantity of fruit. But by the hard oil process, it is impossible, however much care may be used, to produce oil with a Free Fatty Acid content below about 33%. Moreover the oil prepared by this process is liable to slow deterioration. The third group of processes, by which "mixed oil" is produced, are merely various combinations of different parts of the above two processes, and are intermediate in all important respects between the two distinct processes already mentioned.

It was felt that if these processes were studied in complete detail, finding out exactly the stages at which the chief losses of oil take place, and the stages at which the deterioration in the quality mainly occurs, it should be possible, either by a combination of the best points of each process, or by other very simple modifications, to work out an improved native process, *i.e.* an improved process, of an entirely simple nature involving the use of no elaborate or expensive apparatus, and of such a nature that it might reasonably be hoped that it could be copied by ordinary village oil makers. It was hoped that a process of this nature would be evolved, by which as much oil might be obtained as is obtained in the hard oil process, of at least as good a quality as that prepared by the soft oil process, and with the expenditure of very little more labour than is needed in the hard oil process. We believe that success in this has already been achieved; for a perfectly simple process has been worked out, satisfying these conditions, by which our ordinary labourers, without special supervision, produce oil with an acid content varying, in different trials, from 10% to 13%. The investigations are, however, to be carried on for two or three months more, before any attempt is made to try to introduce the process outside; for it is hoped that further slight improvements will be worked out, which will make it possible for oil to be prepared by our improved process, with a Free Fatty Acid content of less than 10%, *i.e.* oil of "edible" quality. Under present market conditions the value of the oil is lessened by roughly 1*s.* 9*d.* per ton for each 1% of free acid which it contains. Thus a reduction from only 33% to 13% in the Free Fatty Acid content of the oil by the use of the new process, as compared with that prepared by the hard oil process, will yield a premium of some 35*s.* per ton, or, allowing for the little extra labour involved, there is roughly a nett gain of about £1 10*s.* per ton. But these figures represent a very conservative estimate of the value of this new process; for the oil produced by the hard oil process generally contains 45% to 60% F. F. A. As compared with the soft oil process, the new one seems to be an even greater improvement from the point of view of the return to the

oil maker, on account of the increased quantity of oil obtainable and some saving of labour. It, of course, remains to be seen whether the native will take to this new process, but it would appear that if the extension work is tackled in the right way, and if we are able to obtain for the man, who adopts our process, the premium which his oil deserves, we ought to be able gradually to get this process adopted generally.

If we succeed in getting this new process generally adopted by the oil makers—though the difficulties and possibilities of failure in such work are obviously great—our oil palm industry will be in a much stronger position for meeting the coming competition from the oil palm plantations of the East, for at least our oil will be of the same quality as theirs. But the fact will still remain that the native, by laborious process, can extract from his fruit little more than half the oil that can be extracted by the use of machinery. Nor can anything alter the economic unsoundness of extracting kernels by such a labour-wasting method as hand cracking. The Chemist has therefore in all this work kept the question of factory extraction in view, and it is believed that a considerable amount of information has been obtained which will be of direct value to the factories by indicating possibilities of further improvement in the mechanical processes and factory technique. These are now being tested in the small scale "model" factory which has been installed at Moor Plantation. Already improvements have been discovered by which the oil extracted from a given quantity of fruit is increased by an important amount at no additional cost. The results of the Chemist's work to date on palm oil and kernels are being presented to the public in a special Bulletin which it is hoped will be printed in April or May, in order that it may be available at the British Empire Exhibition. Arrangements have been made by the Exhibition Commissioner for a full size factory to be shown at work in the Nigerian section of the exhibition.—ANNUAL REPORT OF THE AGRIC. DEPT., NIGERIA, for 1923.

WATSONIAS IN JAMAICA.

MARY SWETTENHAM, BELLEVUE.

Bellevue, Gordon Town, Jamaica, 4,000 ft. high in the Port Royal Mountains, was built by French *emigres* in "THE TERROR." Later it belonged to CAPT. HENRY KENT, R.N., who was present at the battle of Trafalgar, I am told.

By whose agency the beautiful *Watsonia aletroides* was introduced into the garden I do not know, but eighteen years ago I found growing there a few dozen clumps of this beautiful coral-pink flower. In the autumn I had some of these clumps dug up by a native gardener who divided and replanted the separated bulbs. My gardener's methods were primitive. He stuck one end of his pickaxe into the ground, twisted it about, thrust the bulb

into the hole and scratched some earth over it. However, the effect in the spring was beautiful. I was greatly encouraged, and by repeating the digging up, dividing and replanting I soon had a slope of about half an acre below the house planted up.

The late MR. ROBERT SYDENHAM of Birmingham sent me a present of a dozen bulbs of *Watsonia Meriana O'Brienii* (syn. *W. Ardernei.*). Though I had seen pictures of this beautiful flower and read the history of its discovery at the Cape, I had never seen a plant. The bulbs grew and flowered beautifully and formed matted clumps, and amongst the snow-white spikes appeared a sport, I believe, a beautiful, clear Cyclamen mauve, but of the same form as the plant widely known as *W. Ardernei.* I then began to look about for more space for my Watsonias. Above the house is another slope to the summit of the mountain. This was overgrown by a thicket of a species of Bracken Fern—the brilliant bright green of an Irish bog, but in the Summer becoming tinder dry and a source of danger in forest fires. This I had cleared, and by degrees have had it planted with Watsonias of both kinds, leaving Juniper Cedars, Lyonsias, and Clethras, all of which are natives of the high mountains.

I had got paths cut all through my Watsonia field, as being suitable to the surroundings and from the mountain top, with views of the sea and Kingston Harbour on one side and the Blue Mountain Peak on the other, the effect is most exquisite. A friend said a few days ago, "I feel like the gods walking through fields of Asphodel, only Asphodel cannot compare with your flowers!"

Watsonias are seen at their best during the rising or the setting of the sun. They have a quality I have seen in few other flowers—that of a glowing, transparent reflection of light. At dusk they shine, tiny stars of pink.

I have sent a great many of the bulbs to friends in England and Scotland where they have done well on the west coast. I understand Watsonias do well in the Scillies and that they were much admired by the Prince of Wales when he visited Tresco from whence he departed with arms full of them. If they could be cultivated in the south-west of England they should be of great value in the flower market. The flowers carry well and last long in water, and the buds come out as those of Gladioli do.

One and one only drawback might be that here I have observed *W. aletroides* comes a poor colour during the first year after replanting, and that the spikes of kinds twist down stiffly in the form of an S. In the second year these faults do not appear. The bulbs of *W. Meriana O'Brienii* (syn. *Ardernei*) become so matted in four or five years' time they do not flower well and have to be divided.—GARDENERS' CHRONICLE, Vol. LXXV. No. 1955.

PLANT BREEDERS' CONFERENCE AT POONA.

By the courtesy of Dr. W. Burns, Economic Botanist and Principal of the Agricultural College at Poona, India, we learn that the first Plant Breeders' Conference held in the Bombay Presidency was a great success and proved invaluable to the forty specialists who gathered together at the end of April. The plant-breeding department furnished fifteen members, five others were workers engaged under the Sassoon David Trust and Indian Cotton Committee, while the staffs of the Economic Botanist and the Horticulturist completed the attendance. Some of the experts came from so far north as Sind, and so far south as Dharwar. The conference took the form of discussions, with demonstrations carried out in the College laboratories. Dr. H. H. Mann, Director of Agriculture, opened the proceedings, and Dr. Burns presided. The latter advised the mathematical treatment of statistics during plant-breeding experiments and pointed out the need for numerical standards for improved races of plants. The conference decided to recommend that the standard formulæ be adopted by the Department of Agriculture. This recommendation received emphasis from Mr. Nazareth's experiments, which were reduced to mathematical formulæ for the guidance of research workers. During the second day's proceedings the necessity of check plots in plant-breeding was pointed out, and it was stated that plant-breeding work should never be commenced on land of unknown quality ; in connection with varietal forms of agricultural crops this is naturally a matter of importance, especially where high productiveness is the aim. Soil fertility, pure lines, test plots and check plots were all discussed with a view to securing thorough and reliable tests of new plant varieties. The standardising of Cotton measurements was another important matter discussed ; Mr. Patel found after experiments made over four years that the length of the Cotton hairs in the centre of the boll was the only true standard of the general length of the hairs, and the conference agreed that the practice of using the middle hairs as a standard should be continued. The third day the conference was occupied in reports from workers engaged in breeding new varieties of Nanchani, Tobacco, Bajri, Jowar and Safflower. Later, the desirability of uniformity of method and expression was put forward and the conference agreed that all members of the staff engaged on plant-breeding work should use the metric system for linear, superficial, cubical and gravitational measurements except when dealing with large units. The conference proved stimulating and encouraging to all present. Much knowledge was pooled and standardising of method agreed upon. Indeed, the conference was such a success that it is likely to become an annual fixture and is to be held in Surat in 1925.—Gardeners' Chronicle, Vol. LXXV., No. 1955.

POST-GRADUATE TRAINING AT THE PUSA INSTITUTE.

In a Press Communiquè issued on the 22nd June, 1923, the Government of India announced the institution of post-graduate courses for specialists in certain subjects at the Agricultural Research Institute and College, Pusa, and stated that these courses would be confined to distinguished graduates of Universities or Agricultural Colleges and also to students who had undergone training in agriculture and its allied branches in British Universities or in one of the recognized Agricultural Colleges and who possessed suitable qualifications. They have now decided to throw these courses open also to selected officers of the Provincial Agricultural Service provided they are fully qualified to take advantage of them and are recommended by the Government of the Province in which they may be serving. The first course commenced on the 1st November, 1923, and subsequent courses will commence from about the same date annually. The training will last for two years. Applications for further particulars regarding the courses, fees chargeable, etc., should be made to the Director and Principal, Agricultural Research Institute and College, Pusa.

No guarantee of appointment to the Indian Agricultural Service is given to the officers who pass through the training successfully.—AGRICULTURAL JOURNAL OF INDIA, Vol. XIX., Pt. 3.

DEVELOPMENT OF INTER-IMPERIAL TRADE.

The Empire Trade and Industry Committee of the Royal Colonial Institute have during recent years done considerable service to stimulate in every possible way the development of inter-imperial trade. The Committee, within the means at their disposal, endeavour to carry out the following functions :—

(1) To bring before the notice of persons in the United Kingdom likely to be interested, any British product which is characteristic of, or peculiar to, any one of the British possessions.

(2) To introduce the raw materials of the Empire to British manufacturers.

(3) To find for buyers Overseas British manufacturers to make goods hitherto made by ex-enemy countries; or in which there is not at present a good British market.

(4) Generally to deal with any trade enquiry of mutual interest to business men Overseas and British manufacturers and merchants.

These services form a part of the activities of the Royal Colonial Institute, and the Secretary of the Trade and Industry Committee, Royal Colonial Institute, Northumberland Avenue, London, W. C. 2., will be glad to receive enquiries from British subjects interested in the trade and industry of the Empire.

RICE IN NIGERIA.

Some years ago seed of a variety of Ceylon Swamp Rice was distributed by Government in the middle part of the Niger Valley. This imported variety, under the local name of "Maliya" has entirely replaced the native variety over large areas. During the last two years tests have been carried out at Ilorin in comparing the yields of the native variety, the Maliya, and also two newly imported varieties of Guiana rice. The results of the experiments in 1922 were that the Maliya yielded half a ton, or almost exactly 100%, more than the native variety. In 1922-23 the Maliya yielded a ton per acre more than the native variety, which represents an increase of more than 200%. In both years a Guiana variety ("Creole") has yielded some 700 or 800 lb. more than the Maliya. These differences are very much greater than the probable error of the experiments, and there is no doubt that whilst the Maliya is a great improvement on the native rice in yield as well as in quality, "Guiana Creole" is again an improvement on the Maliya. Seed of the Guiana Creole will now be offered to the growers. The adoption of these improved varieties, in place of the native variety, must mean an increased return of several pounds sterling per acre.—Annual Report of the Agric. Dept., Nigeria, for 1923.

MECHANICAL CULTIVATION OF MINT.

L. FONDARD AND E. AUTRAN.

The authors have studied the methods to be adopted in the mechanical cultivation of mint. Their experiments were conducted with a view to deciding questions relating to: the spacing of the rows, depth of planting, moulding up soil, cutting the rhizomes.

Spacing of the Rows.—The best distance between the rows was found to be 60 cm., as this allows planting, hoeing and moulding up to be effected by a specially mounted horse-hoe. The returns were the same as when the rows were planted closer together.

Depth of Planting—It is generally thought that mint plants should only be covered with about 2 cm. of loose soil. This rule cannot be followed if a horse-hoe is used, but the authors have found that mint rhizomes take no hurt if covered by 2 to 5 cm. of soil which makes it possible to dispense with hand-hoeing.

Moulding Up.—The results obtained by the different treatment of the 3 plots were as follows :—

(1) Control plot, not moulded up, average growth; (2) a little moulded up, development fairly good; (3) much moulded up, the plants grew thicker and taller than in the case of the other two plots,

Cutting the Rhizomes.—The rhizomes of mint bear cutting very badly. If the rhizomes are 2 3 cm. long the plant grows unsatisfactorily, only reaching a height of 7-10 cm. Rhizomes cut back to 7-8 cm. produce irregularly-growing plants ranging from 25-30 cm. in height. When the rhizomes are left entire, the plants grow to 40-45 cm.

Cost of Cultivation,—The data summarised in the appended table show that it is possible to obtain a profitable crop by mechanical cultivation.—International Review of Science and Practice of Agriculture, Vol. II, No. 1.

A THIN SHELLED VARIETY OF THE QUEENSLAND NUT.

(*Macadamia ternifolia.*)

C. T. WHITE, GOVERNMENT BOTANIST.

It is unquestionably granted on all sides that one of the finest flavoured nuts in cultivation is the Queensland Nut or Bush Nut (*Macadamia ternifolia.*) It is a nut particularly suitable for high class confectionery, but a great objection to its use on a very large commercial scale has been the very hard thick shell (putamen) in which the kernel is enclosed.

The nut has attracted some attention outside Australia, thus E. ANDRE, the well-known French horticulturist, writing to the "REVUE HORTICOLE,"* says—"The ripe fruit, however, is more particularly interesting, Usually one of the ovules is abortive, and the surviving one fills the whole of the interior of the shell with its white, firm, close-grained albumen, forming a kernel which is as crisp as that of the hazel nut, but has a higher aroma and a finer flavour. We have gathered and eaten these nuts in the month of December. *Macadamia ternifolia* is a tree which should be cultivated, both from an ornamental and economic point of view. Even if it yielded no fruit, it would make a fine appearance in gardens in the South of France, where the specimens already planted have passed uninjured through winters as severe as that of 1890-91, but how greatly enhanced would be the interest and importance attaching to these species if we could look forward to the discovery of some feasible mode of inducing the trees to yield a regular supply of their pleasantly flavoured nuts."

E. POPENOE, writing on the "Tropical and subtropical Fruits of California",† says—"The drought-resisting qualities of this tree make it of value for semi-arid regions, while its ornamental appearance commends it for culture in every garden. While very few trees are yet in bearing in the State, several thousand young plants have been disseminated by the nurserymen within the last few years, and the tree promises to become popular, not only for the home garden or orchard, but commercially as well."

The tree is a native of Southern Queensland and Northern New South Wales, being quite plentiful in many of the coastal scrubs (rain-forests). It is found in heavy rain-forest country such as the Northern Rivers (N.S.W.), Tallebudgera (Q.), &c., and drier scrubs such as Mount Bopple (Q.), &c. It is to be noted that the tree is spoken of in America as one being particularly drought-resistant; and it is interesting to note that in its natural habitat the species finds its greatest development on the one hand in heavy rain-forest country such as that on the Tweed River with an average rainfall of 70 in., and on the other hand in drier "scrubs" (rain-forests) to the north and west of Gympie with an annual rainfall of approximately 45 in. These instances go to show that the tree can be grown under a variety of conditions.

*Translation from MAIDEN'S FOREST FLORA OF N.S.W., Vol. I. page 218.

†JOURNAL OF THE ROYAL HORTICULTURAL SOCIETY, ENGLAND, Vol. XXXIX., page 336.

Mr. J. B. Waldron, of Upper Eungella, Tweed River, New South Wales, has for some years past given a good deal of attention to the Queensland Nut, and has among a large collection of varieties or forms growing on his place a particularly thin-shelled one which should have considerable possibilities as a commercial nut. The shell measures in parts only 1 mm. (½ line) in thickness, and in addition to being thin, usually cracks along one side of the suture so that a penknife can be inserted and the shell opened and the kernel extracted with great ease. The Department has secured from Mr. Waldron a number of seeds of his thin-shelled variety, and it is intended to raise a number of plants to see if the variety will come true to seed, and to keep on improving it by selection so that eventually a race of large thin-shelled nuts may be produced. It is further intended to try other methods of propagation in an attempt to perpetuate the variety in case seedlings should not come true.—Queensland Agric. Journ., Vol. XX., Pt. 2.

TREATMENT OF COTTON SEED WITH VARIOUS PASTES.

M. J. E. SQUIRE.

Experimentalist.

Results of treating cotton seed with superphosphate paste for the purpose of getting rid of the "fuzz," which prevents it from running freely through the plate in the maize drill, were reported in this *Gazette* in January. Similar experiments were recently carried out at Hawkesbury Agricultural College, pastes of superphosphate, gypsum, and agricultural lime being tested as adhesive agents, and the effect on the germination of the seed noted. As the cotton seed used for sowing the College plots had been treated with sulphuric acid, this treatment was also included in the trial so that a comparison could be made.

The superphosphate paste gave the best gumming effect, and set very hard on drying. The lime was fairly effective, but the gypsum had a tendency to powder when dry, and to shake out when the seed was handled, and when in the seed-box of the maize drill. By using a ten-hole plate (9/16 inch holes, ⅜ inch thick), seed of all three treatments were worked through the drill, the seeds being dropped three and four at a time every 8 inches in the row. All the seed, however, had a tendency to hang together, and needed to be constantly stirred in the seed-box, the gypsum-treated lot being the worst. The effect of treating the seed with sulphuric acid was to burn off the fuzz, and the seed was then washed in clean water. For the sowing of this seed a 20 hole plate (7/16 inch holes, 3/16 inch thick) was used. Seeds were dropped two or three at a time every 6 inches, and this was most satisfactory.

The results of the germination tests in the soil were as follows:—

Treated with gypsum paste	94 per cent.
Treated with sulphuric acid	93 ,, ,,
Untreated	88 ,, ,,
Treated with agricultural lime	84 ,, ,,
Treated with superphosphate paste	62 ,, ,,

The seed treated with gypsum paste, that treated with sulphuric acid, and the untreated seed came up a day before the lots treated with lime and with superphosphate, which on coming up had a difficulty in shedding the old seed-coat. A number of young plants from the seed treated with lime paste died off shortly after coming up.—Agric. Gaz., N.S.W., Vol. XXXV., Pt. 5.

LIBRARY.

THE COCONUT PALM.*

The literature relating to the coconut palm has consisted chiefly of compilations, many of which, as one bewildered reader said, contradicted on one page what had been stated on the page before. PREUSS, DIE KOKOSPALME aimed at better things, but COPELAND'S book was the first real work on the subject. There was, however, still room for a manual of coconut planting, descriptive of conditions in India, Ceylon, and Malaya, and the appearance of SAMPSON'S book, The Coconut Palm, was awaited with interest. This was published last year, and it was accorded the customary congratulatory welcome in the TROPICAL AGRICULTURIST for September, 1923. It is proposed to deal here with some points which are debatable, or which call for attention in the preparation of a second edition.

In an expensive book of this character, one would perhaps be justified in expecting to find comparative descriptions of methods of cultivation in different countries, and a fairly complete summary of the available scientific information. That has not been achieved. The book is rather an account of the coconut in India, practices in other countries being dismissed somewhat summarily, and the results of scientific investigations being for the most part ignored. The botanical part might have been made more complete by reference to work done in the Philippines and elsewhere, especially as several of the facts recorded conflict with previous accounts.

The author's original contribution to the subject deals with the habit (arrangement) of the roots of the coconut, and as it seems to have led him to attribute all the good and bad fortune of the coconut to its roots, it is worth while to consider his data. He examined forty seedlings, four months old, forty-three young plants two years old, six bearing trees, 20-25 years old, and an old tree. In the first of these classes, the plants were not yet independent of the seed-nut, and the same may have been true of the second class; in both cases the plants were too young to afford any valid data concerning the effect of the roots on the development of the shoot, or *vice versa*. Only the six trees of medium age could provide any evidence, and in their case it is contradictory. They included three trees which bore regular crops, and three which fruited irregularly. All three of the irregular bearing trees produced leaves and spathes more rapidly than the first of the regular bearing trees. There is no evidence which would contradict the prevailing view of the reciprocal influence of the aerial and subterranean parts of a plant.

The author has done good service in directing attention to the distribution of the roots of the coconut, and the effects of cultivation on that distribution. But we think that he drives his observations too hard. Roots

* *The Coconut Palm*, by H. C. SAMPSON, B.Sc., C.I.E., JOHN BALE, SONS, AND DANIELSON, LTD., Price 31/6*d*.

crop up (in his book) in the most unexpected places. On p. 96, he emphasises "the importance of selecting seed-nuts from trees grown on land with similar soil conditions to those (*sic*) which are to be planted up," in order to obtain trees with a similar root habit. But, as he repeatedly recognises elsewhere, the arrangement of the roots is largely controlled by soil conditions, and it would not be wrong to assert that no character of the coconut palm is more readily altered by alterations in those conditions. That there are different fixed types of root habit in the coconut palm, and that such habits are inherited, is quite unproved.

We think that if the author had examined the roots of other monocotyledons, he would have found that the root habit of the coconut is not unique, as he appears to suppose. Plate 1 shows the typical root habit of a monocotyledon. The distinction between "water roots" and "feeding roots" is liable to mislead; if a root absorbs food, it can only do so by taking in water; and conversely if a root absorbs water from the soil, it will at the same time absorb some plant food.

In describing the stem, the author states that the internal strands run from one side to the other. They run spirally in three concentric layers, the direction of the spiral being reversed in the middle layer and the outer spiral being either right or left-handed. This might have been correlated with the right or left-handed spiral arrangement of the leaves.

The description of the leaf arrangement given on p. 38 is unintelligible to a botanist until he realises that the author's use of the term spiral is not that employed in writing of phyllotaxy. And we think that the average cooly will find a much easier way of determining which is the next oldest bunch than by estimating an angular distance of 140° (p.104).

The description of the flower, in general, confirms previous accounts. The statement that it has three stamens should have been corrected. Fig.4b (upper) does not show the fruit coat "emerging from" the perianth, as the stigma is closed when the fruit first emerges. The canal from the stigma to the ovary is not a style. One previous account of the flower states that there is a nectary at the base of each segment of the stigma. Another observer denies that. Our author has observed the liquid, but claims that there are three honey glands situated at the base of the flower, with ducts which open between the lobes of the stigma. The alleged ducts appear to be the lines of union of the carpels; evidence is needed to establish the existence of the function claimed for them. The water pores round the apex of the female flower are not mentioned.

In the author's opinion, the coconut is pollinated by insects, chiefly bees. "It is thus evident that Nature has intended that the flower should be fertilised by the aid of insects". (Nature, with a capital N, appears to exercise a special guardianship over the coconut.) But it is not a question of what Nature "intended", but of what actually happens. Bees certainly visit the male flowers; but one observer who is interested in bees informed the reviewer that they collected pollen. Has anyone observed bees visiting the female flower?

The book is remarkable for its teleological and anthropomorphic explanations, far too numerous to quote. The author attributes to the coconut palm, faculties which plants are not believed to possess, except perhaps in

India. "When the tree is aged and has commenced to decline, the base of the bole commences to decay and the tree may then produce roots above the normal root-producing area *in its endeavour to maintain life*" (italics ours). We picture the tree considering the matter. "My old roots are wearing out, it is time I got some new ones." Perhaps the most striking instance is on pp.96,97 : "It is a generally accepted theory that seed should not be taken from young trees. These have not yet reached a stage when the question of the reproduction of the species is one of pressing importance to the tree." Does the tree practise birth control at first, and wake up later to a sense of its responsibilities?

The author quotes a generally accepted theory that seed should not be taken from young trees. It is certainly a widespread belief in the East, but is there any evidence in support of it? The plant-breeder does not discard the first seeds produced by a plant. We are told in this book that seed-nuts should not be taken from old trees because they are smaller than the average and may not contain sufficient food ; and also that they should not be taken from young trees because such nuts are larger than the average. Presumably the latter contain too much food! The difficulty of examining the nuts on old trees (p.97) is no argument against the use of such nuts for seed.

From the view-point of both botanical fact and botanical theory it would have been an advantage if the book had been submitted to a botanist for revision.

On p. 18, the author writes:—"There is another way also by which an old tree is saved. A platform is built high up around the stem. Soil is then piled up around the tree on this and if this is kept moist a fresh root system is formed in this soil. The tree is then cut down below this new root system and the top is planted in the ground." Has he ever seen this done? Does it not rank with the monkey fable? Obviously the planted stem would decay up the centre. One well-known Ceylon coconut planter frequently declared his intention of doing this, but we are not aware that he ever carried it into effect.

One much discussed question of coconut planting is the depth at which the seedling should be planted. The method now in favour in Ceylon is to plant the seedling in a pit, the surface of the soil in the pit being below the surrounding level. It has, however, to be borne in mind that there are large numbers of coconut palms in Ceylon which have been "surface" planted and consequently the Ceylon planter is not without experience of both methods. Moreover, there is a good deal of loose description about the pit method, which may mislead planters in other countries. When a man says that he makes holes two or three feet deep, he does not necessarily mean that he plants the seedling at the bottom of the hole. The hole is partly filled up, and probably in the majority of cases to within eighteen inches of the surrounding level. It is astonishing how deep one foot looks when measured vertically.

In common with several writers in other countries, MR. SAMPSON does not favour the pit method. Here the question of roots really comes in. MR. SAMPSON states that there is a definite root-producing area confined to the basal 1½ to 2 feet. From a botanical standpoint that cannot be

maintained. At least every leaf scar is a potential root-bearing area (see the last paragraph but one), and it is quite common to see bunches of roots round areas on the stem where the outer tissues have decayed, or where a coconut palm leans against an old wall. The production of roots in such cases depends on the presence of moisture. Further, if the outer tissues are cut away anywhere on the lower four feet of an old stem, numerous rudiments of roots will generally be found embedded in the stem.

In many surface-planted trees, which the reviewer has had dug up, the base of the bole has been nine inches or so below the surface. After that region has become covered with roots, the tree produces other roots above ground and forms the well-known cone of roots, some of which reach the soil while others do not. It is surely preferable to have those roots below ground. Even deeply-planted palms may ultimately produce roots above ground, but they will not do so as soon as surface-planted palms.

It is remarkable that when the author desires to show the course of the roots in the coconut palm, he gives a diagram (plate III) of the root system of a deeply-planted tree, which has the base of the bole four feet below the surface. Thus he illustrates the normal habit of the roots by reference to a tree planted in a manner he condemns. Surely this example should have been discarded, and a diagram given showing the course of the roots in a surface-planted tree.

Since there is so much difference of opinion on this subject, we turned with interest to see what the author's recommendations were. He advises (p. 125) that " The general rule should be that the *top of the seedling* (italics ours) is just buried when the soil has been pressed round the planted seedling." Of course, he does not mean that. Nevertheless, that is what he says.

And that brings us to another point. The book is very loosely written, and the author frequently says what he does not mean. There is a weakness over singulars and plurals, and a misuse of pronouns which pulls the reader up short repeatedly. Some mistakes in spelling occur almost invariably, *e.g*, pet*e*ole, meal*l*y; and scientific and proper names suffer, *e.g*. Prudho*l*me. Sporosa, Crot*o*laria, Centrosema Plume*r*ii, *Caf*ea robusta.

The "serious objection" to planting seed-nuts upright, given on page 108, is much too far-fetched.

We wish that jungle stumps (p. 117) really did disappear in two or three years.

The author (p. 89) states that if given good drainage the coconut is one of the most drought-resisting trees. That will be good news for Batticaloa, though the difficulty will be, in anthropomorphic phrase, to persuade the palms to believe it. A tree which requires 50 inches of rain per annum, and that not too restricted in time, cannot be regarded as one of the most drought-resisting. The North-Central Province of Ceylon is a standing disproof.

The chapter on cultivation (p. 127) is prefaced by a somewhat lengthy introduction to explain why the author is better qualified than any one else to deal with the cultivation of coconuts. We do not question his qualifications, but unfortunately his historical summary is based on misconceptions. Tea is not solely an up-country product in Ceylon. The low-country districts of Ceylon (and the sequence of crops can scarcely refer to any other country) were originally opened up in sugar, Liberian coffee, and tea. Moreover, the low-country planting districts of Ceylon are not level land, but almost as hilly as up-country districts. When rubber replaced tea in the low-country, it was not planted, except for an odd field or two, on flat land, and the only possible methods of cultivation are those of hand labour.

Further, the tea or rubber planter did not subsequently take up coconuts and transfer his methods to them. Coconuts in Ceylon antedated both tea and rubber, and, save for a few exceptions which "prove the rule", they have not been planted by European Companies.

There can be few trees which have been subjected to such detailed chemical analysis as the coconut palm. May it be that this frequent re-examination is a sign of the inadequacy of chemical analysis to provide the information the planter wants? It has been recognised for many years that the only way of determining what a plant requires is to subject it to manurial experiments, but old ideas die hard. MR. SAMPSON gives a fresh set of figures, with elaborate illustrations.

He remarks that "The coconut tree offers, perhaps, more scope for the investigation of the food requirements of a plant than any other. The development of new leaves, new fruit branches, and new fruit takes place at such regular intervals, and the fruits take such a long time to mature, that it is possible to take samples for analyses at definite stages in the development of the part required." But as far as regards manuring, is not the conclusion exactly the opposite of that in the first sentence quoted? The tree has to be manured as a whole, and all stages of the nuts are present at the same time. Consequently, it is all the more difficult to determine "the movements of the various elements of plant food taken from the soil," and from the planter's point of view this detailed analysis of all the separate parts is of little value.

As illustrating the value of analyses, attention may be directed to those of a "barren" tree, *i.e.*, a tree which bore male flowers only, and a bearing tree, on pp. 184,185. Relatively to the dry weight, the barren tree, in general, contains more potash and phosphoric acid in the parts analysed, than the bearing tree.

The elaborate diagrams showing the distribution of potash, etc. in the various parts of the plant are interesting, but they must have added largely to the cost of the book, and for the reason already given their utility is doubtful. To illustrate properly the points aimed at, the colours should surely have indicated the amounts of potash, etc., relatively to the dry weight, instead of the percentage in the ash, as percentage of ash to dry weight varies in the different parts analysed. It would have facilitated comparisons of the analyses, if the data had been arranged always in the same order of parts analysed, instead of in numerical order of percentages.

In the discussion of the separate constituents, we meet the usual teleological explanations. Potash is said to be stored in the husk, because it is wanted at the time the roots have ramified through the husk. The author fails to understand that many of the substances found in fruits are there because they were required in the formation of the fruit, or are the metabolic products of that process, and as far as the next generation is concerned their presence is accidental. We are unable to picture the coconut palm deciding that it will store its phosphoric acid inside the nut because the seedling will want it early, but will put its potash in the husk because it will not be required until a later stage. And, on the usual assumption that the coconut is adapted for fruit dispersal by water, the palm would appear to have made a mistake.

We note (p.212) that underplanting old coconut palms with fresh seedlings is "Nature's way of planting." It is also "Nature's way" of killing out seedlings.

There are numerous other points which should be noticed, but we have already exceeded our space. The book contains much useful information, though it must be read with caution. Given pruning and revision, it would form the nucleus of a standard work on the coconut palm.

MARKET RATES.

MARKET RATES FOR SOME CEYLON PRODUCTS.

(FROM THE CEYLON CHAMBER OF COMMERCE WEEKLY PRICE CURRENT, DATED 14th JULY, 1924.)

NAME OF PRODUCE		CURRENT PRICE			REMARKS
		Rs. cts.	at	Rs. cts.	
CARDAMOMS					
All round parcel well bleached	per lb.	... ...	,,	... ...	
Do do medium	do	... ...	,,	... ...	
Special assortment 0 & 1 only	do	... ...	,,	... ...	
Seeds	do	... ...	,,	... ...	
Green	do	2 40	,,	2 50	
CINNAMON QUILLS—(At Buyer's Stores)					
Ordinary assortment (in bales of 100 lb. nett)	per lb.	0 65	,,	0 69	
No. 1	do	0 68	,,	0 72	
No 2	do	0 66	,,	0 70	
No. 3	do	0 63	,,	0 67	
No. 4	do	0 60	,,	0 64	
CINNAMON CHIPS—Maradana, (At Buyer's Stores) (in bags of 56 lb. nett) per candy of 560 lb.		60 00	,,	65 00	
CITRONELLA OIL—(ex-Seller's Stores without packages) ...	per lb.	2 00		2 10	
CACAO—(At Buyer's Stores)					
Estate—Finest	per cwt.	50 00	,,	58 00	
Do Medium	do	37 00	,,	52 00	
Do Common (Black)	do	10 00	,,	20 00	
COCONUT—(Desiccated) Granulated goods (Delivered at Wharf or Buyer's Stores)					
Assortment: Medium 50 per cent. Fine 50 per cent. ...	per lb.	0 20¼	,,	0 21	
COCONUT OIL—					
White Oil f.o.b	per ton	575 00	,,	600 00	
Ordinary Oil do	do	560 00	,,	565 00	
COPRA—					
Calpentyn	No. 1 quality per candy of 560 lb.	76 50	,,	84 00	
Estate	,, ,,				
Ordinary quality (Maravila)	,, ,,				
Cart Do do	,,				
FIBRES—(At Buyer's Stores)					
Coconut Brisle No. 1	per cwt.	11 50	,,	13 50	
Do No. 2	do				
Coconut Mattress No 1	do	2 85	,,	3 25	
Do No. 2	do				
Coir yarn Kogalla Nos. 4 to 9	do	12 50	,,	25 00	
Do Colombo Nos. 3 to 7	do	12 50	,,	25 00	

PLUMBAGO		X. B.			B			B. E.		
		Rs. cts.		Rs. cts.	Rs. cts.		Rs. cts.	Rs. cts.		Rs. cts.
Ordinary Lumps	per ton	250 00	at	350 00	215 00	at	250 00	150 00	at	180 00
Chips ...	do	175 00	,,	250 00	150 00	,,	200 00	100 00	,,	140 00
Dust	do	100 00	,,	175 00	70 00	,,	125 00	40 00	,,	75 00
Do Flying	do	60 00	,,	145 00	40 00	,,	95 00	25 00	,,	60 00

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st JULY, 1924.

Province, &c.	Disease	No. of Cases up to date since Jan 1st, 1924	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	629	151	224	361	35	9
	Foot-and-mouth disease	1113	696	850	7	256	—
	Anthrax	7	2	—	7	—	—
	Hæmorrhagic Septicæmia	6	—	2	4	—	—
Colombo Municipality	Rinderpest	398	71	(In	June)		
	Foot-and mouth disease	45	44x	"	"		
	Anthrax	—	—				
	Rabies	—	—				
Cattle Quarantine Station	Rinderpest	10	—	(In	June)		
	Foot-and-mouth disease	27	—x	"	"		
	Anthrax	116*	14	"	"		
	Pleuro-Pneumonia (in goats) †	85‡	7	"	"		
Central	Rabies (Dogs)	12	7	—	12	—	—
	Foot-and-mouth disease	455*	320	423	7	25	—
	Anthrax	8	—	—	8	—	—
	Hæmorrhagic Septicæmia	1	—	—	1	—	—
	Piroplasmosis	4	—	4	—	—	—
	Mange (in Buffaloes)	4	—	4	—	—	—
	* 39 cases mouth disease in goats						
Southern	Rinderpest	16	16	3	6	7	—
	Foot-and-mouth disease	2	—	2	—	—	—
	Anthrax	—	—	1	—	—	—
Northern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	—	—	—	—	—	—
	Hæmorrhagic Septicæmia	98*	—	3	95	—	—
	* 23 cases amongst goats						
Eastern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	1	—	1	—	—	—
	Anthrax	—	—	—	—	—	—
North-Western	Rinderpest	243	—	92	146	—	5
	Foot-and-mouth disease	541	370	376	1	163	1
	Anthrax	12*	—	—	12	—	—
	Rabies (Dogs)	1	—	—	—	—	1
	* 1 dog						
North-Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	108	12	108	(In	June)	—
	Anthrax	—	—	—	—	—	—
Uva	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	3	—	—	3	—	—
	Black Quarter	26	11	—	26	—	—
Sabaragamuwa	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	948	594	746	5	195	2
	Anthrax	12	—	—	12	—	—
	Hæmorrhagic Septicæmia	3	—	—	3	—	—
	Rabies (Dogs)	2	—	—	1	—	1

x Figures for July not yet to hand
† 2 cases amongst cattle, the rest amongst goats
‡65 amongst 97 goats imported by Mr. C. E. A. Dias on 5th March, 1924.

M. CRAWFORD,
Acting Government Veterinary Surgeon.

Colombo, 8th August, 1924.

METEOROLOGICAL
JULY, 1924.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of Cloud 0=clear 10=overcast	Mean Wind Direction during Month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy Days	Rainfall: Difference from Average
	°	°	%			Miles.	Inches		Inches
Colombo Observatory	80·9	—0·1	83	8·9	SW	142	13·76	24	+7·75
Puttalam	81·6	—0	78	4·4	SW	312	1·71	9	+1·17
Mannar	85·0	+1·4	72	7·4	SW	264	0·00	0	- 0·38
Jaffna	83·3	+0·3	77	6·4	SW	432	0·07	3	- 0·86
Trincomalee	85·3	+0·1	63	7·0	WSW	303	1·91	3	- 0·12
Batticaloa	84·3	—0·3	68	5·9	SSW	121	0.48	3	- 0·79
Hambantota	81·4	—0·2	79	4·9	WSW	353	8·18	11	+6·51
Galle	80·2	+0·3	82	7·1	W	308	8.96	23	+2·84
Ratnapura	80·2	—0·1	84	7·8	—	—	16·42	26	+3·56
Anu'pura	82·6	—0·7	71	7·0	—	—	0·81	12	- 0·46
Kurunegala	80·0	—0·6	80	8·4	—	—	8·13	22	+4·12
Kandy	76·0	+0·2	82	8·4	—	—	10·36	25	+2·86
Badulla	75·3	+0.1	75	6·8	—	—	0·23	6	- 1·76
Diyatalawa	70·8	+0.8	66	7·6	—	—	0·60	5	- 1·51
Hakgala	61·1	—0·1	87	8·5	—	—	9·29	26	+2·37
N.' Eliya	60·2	+1·2	90	9·3	—	—	15·93	28	+3·86

The rainfall experienced during the month has been consistently above normal to the South and West of the Island and on the Windward slopes of the Hills. For the remainder of the island it was in deficit.

Where rain was experienced it was well distributed throughout the month and though in excess in the rainy district on the western slopes, no station here reported a fall of over five inches of rain for the day.

The mean daily temperature has been, on the whole, about normal.

Wind Strength, Humidity, and the clouded state of the sky have been above normal while air pressure was slightly below.

J. E. EVANS,
For Supdt., Observatory.

SISAL HEMP, MAHAILLUPPALAMA.
(Ceylon Hemp & Produce Co.)